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Philip Keevil RIBA

UNRESTRICTED

FEASIBILITY OF REPRESENTING SELECTED ELEMENTS OF THE 1985 BUILDING REGULATIONS IN PROLOG OR OTHER RULE-BASED FORM

Dissertation offered for the degree of Doctor of Philosophy

T 9 The Open University

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Feasibility of Representing Selected Elements of the 1985 Building Regulations in Prolog or other Rule-Based Form

Philip Keevil RIBA

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Abstract

This dissertation examines the proposition that there is a consistent and repeatable internal structure within regulations. This is demonstrated to be the case for regulations which make up *The Building Regulations 1985*, which is used to illustrate many of the arguments discussed. The outcome of the research is the representation of a series of example regulations to reveal the nature of their internal structure. The form that the internal structure takes is embodied in a series of linked data structures known as 'frames' using the Prolog computer language.

Evidence for the existence of an internal structure is based upon data obtained from analysis of one year's Appeals and Determinations in a report taken from a series published from time to time by the Institute of Building Control.

Theories about the nature of prescriptive rules are discussed to introduce the subject of regulations which are described in the light of relevant legal theories about rules in general. To clarify the issues involved a systems model is proposed to provide an overview of the building regulations process. The history of regulatory control of building construction in this country is described as a prelude to considering the nature of disputes and the type of information they can yield to support the thesis. Research into the application of Artificial Intelligence techniques for processing legal statements is reviewed to establish how such experiments relate to the concept of internal structure in regulations. The appraisal identifies a number of representational problems that restrict presentation of the internal structure. The dissertation is supported by worked examples of regulations that have been analysed and by output from a sample analysis session.

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CHAPTER 1 INTRODUCTION

Abstract

This dissertation considers whether it can be shown that regulations have a repeatable internal structure, which can be used to improve our understanding of how they function and to provide a basis for predicting outcomes of disputes. It demonstrates this for one example set of regulations - The Building Regulations 1985.

It finds that:

- *major causes of regulations being applied unevenly are:*
  - *a) determining which situations trigger individual regulations, and*
  - *b) agreeing the constructional methods which achieve compliance with the stipulations of the regulation invoked.*
- *a systematic procedure for the analysis of regulations can be introduced based on an understanding of their structure.*
- *the procedure can be computerised and there are clear advantages from doing this.*

It finds vagueness of classification to be an inevitable barrier to precise communication. By analysing documented disputes it is shown that, surprisingly, nearly 50% are caused by uncertainties in the specification of the situation triggering the regulation.

Two reasons led to the choice of "The Building Regulations 1985" as the vehicle for investigating the structure of regulations. The first being the extensive professional experience of applying the building regulations and debating their meaning with building

control officers; and the second the availability of reports of formal disputes.

This first chapter sets out the background to the subject by giving an outline of the main arguments. It explains why the question of whether regulations have an internal structure is worth investigating.

1.1 BACKGROUND

The internal structure of regulations is the central topic of this dissertation, which shows that this structure can be represented in a repeatable template for *The Building Regulations 1985.*

1.1.1. The context of regulations

Regulations have an increasing impact on our activities and this is especially true in the case of the construction industry which is controlled by a wide range of regulations. In addition to the Building Regulations, there are, for example, the Health and Safety regulations and special requirements dealing with different building types.

> "Regulatory information has a direct and significant effect on the safety, economics and quality of many industries' operations and end-products. However, documents setting out standards are often voluminous and can be complex. Users of such standards need to invest considerable time and effort to become familiar with the structure and content of the documents. Therefore, it has long been recognised that computer handling of this information is a potentially useful application area." [1]

Locating the subject of a regulation's underlying structure in its context has meant referring

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[1] [Chung/Stone94, p.147]

to paradigms within several disciplines. This was found to be necessary to take into account ideas relevant to the understanding, production, and application of regulations. Although outside the direct focus of the investigation, the most important disciplines, which have a bearing on the subject of regulations, are law and sociology.

The impact of regulations has grown steadily over the last three decades. The Building Regulations are the main controls that impact daily on architectural practice. The original Model Bye-Laws that governed building construction up to 1965, depended on the area of the country where a building was being erected, and were around 60 pages long. The modern equivalent is about the same length, but relies on nearly 340 pages of supporting documentation, many of which refer to other Codes of Practice and British Standards. The supporting documentation, the Approved Documents, includes worked examples and diagrams to help make the requirements easier to understand. However like most examples of technical regulations, they contain errors and ambiguities embedded in an industry-specific language. Certain words and phrases have acquired special meanings over time in the building industry, and these lead to complications in ensuring compliance where alternative interpretations are possible. This problem affects not only architects and builders trying to get projects completed but also the Building Control Officers who have to enforce the rules.

This state of affairs is not confined to building regulations alone. Most of the many sets of regulations applying to the construction industry exhibit the same phenomena. The encumbrance of coping with even more legislation as a result of membership of a larger administrative unit, the European Community, has already begun to create an extra workload for the profession.

1.1.2 Personal experience

Investigations have been restricted to a single set of regulations in a field in which the writer has had many years of practical experience. Dealing with most building types over

30 years in private architectural practice has established that a large proportion of professional time is spent complying with the many types of regulations which affect the construction industry. A large part of professional fees goes towards paying for time spent trying to work out exactly what is required by different sets of regulations, and in negotiating with the controlling authority. Much of this time occurs in the design phase of a project, in attempting to balance the various constraints which make it difficult to meet the client's needs within tight cost limits. Extra time is spent negotiating with the representatives of controlling authorities, and in trying to establish precisely which particular solution complies with the relevant regulations.

The regulatory process has been encountered by the writer in several different situations. The first of these has been involvement in a number of RIBA committees tackling various aspects of professional practice. This work built up a clear picture of the inevitable burden of regulations on the building design professions - from consulting engineers to planners and contractors. A second field of activity was in helping to lay down standards in a Local Government office and later as a partner in private practice. Additional insight into demands created by the interaction of regulations came from teaching professional practice for a few years. In each of these varied roles the existence of regulations has always been a major part of the field of interest.

Contact with other sets of regulations within the construction industry leads to a view that many of them exhibit similar difficulties in their application and may share internal structural features with the Building Regulations.

1.1.3 Questions about the operation of regulations

Discussions, over many years, with parties affected by the application of building regulations has reinforced the impression that most persons involved in ensuring regulatory compliance experience difficulties. This is especially true when new regulations are introduced. The general view seems to be that regulations are an inevitable part of

working life and that the confrontational position between applicant and enforcer will always be with us. Current trends towards self-assessment regulatory regimes remove some of the tedium of obtaining approval but the onus is now on the person affected by the regulation to prove compliance should an authority form the opinion that a breach of a regulation has occurred. This situation replaces the tedium of negotiation with the nagging doubt that attempts at compliance have missed some vital point. Past personal experience has shown it is likely to be difficult to obtain agreement on the meaning of a regulatory clause, if an authority decides to invoke sanctions.

Over the years, many questions about the way in which regulations operate have remained unanswered. Why is it so hard to be clear about what are apparently straightforward regulatory statements? How is it that two trained and experienced members of the industry can take different positions about a simple technical issue? Does this situation occur outside the construction industry? What is it about a regulation that causes this situation? Could it be that the confusion implicit in the regulatory process is a reflection of gaps or inconsistencies in the underlying structure of regulations? Would it have been easier to obtain a consensus on the real meaning of a regulation if it were recognised that there is an internal structure to regulations and that it could be used to validate their format? Is it possible that converting the regulations into computer processible format would help to clear up some of the complications?

The last question led to this research, after a number of enquiries to construction industry professional institutes established that the creation of regulations was regarded by many as a "craft". The head of the department responsible for drafting the building regulations stated that there is no straightforward method for writing clear regulations, which he regarded as a skill requiring special aptitude and long experience. This view may be considered to imply scope for personal idiosyncrasies and stylistic approaches, which might detract from the construction of regulations to fulfil a specific function.

1.1.4 Is there a structure of regulations, which influences their function?

The performance of many things, from the internal combustion engine to committee meetings, is influenced by the way in which they are put together. The linkages and sequence of operations set performance limitations on what is, and is not, possible for the mechanism under consideration. Considerations of this sort led to the notion that regulations might also have a structure, which would help us to understand better, the way in which they work and what the limitations are on their operation. If it were possible to identify the individual components making up the regulation, the connections binding between them together, and their interdependencies, it might be possible to obtain a working understanding of how each plays its part in the operation of a complete regulation.

A framework has been sought which is consistent across *The Building Regulations 1985* and into which the words or phrases used by the regulations can be inserted irrespective of the order of words used in the official version. The term 'template' is used in this thesis to refer to the overall framework which represents the internal structure identified by the investigation. When there is insufficient information provided by the written regulation to fill the designated spaces within the template it reveals a gap in the regulation.

1.1.5 Possible use of computers

In the 1980s the emergence of simple, low cost expert system shells gave further stimulus to the notion that it might be possible to improve the accessibility of regulations, and the predictability of their requirements, by reducing them to their core components to obtain a degree of automated interpretation. Perhaps it would be possible to codify, classify or organise sets of regulations such as the building regulations in such a way as to reduce the amount of time and money lost in lengthy discussion? If a consistent framework such as an internal structure *is* present it could be the basis for computer processing.

However, simple tests showed that the complexity of the typical grammatical structure of a regulation made translation into computer processible format extremely difficult. Far from improving the comprehension of regulations the artificial language required an intermediate form to enter clauses into an expert system shell with the result that the regulation lost much of its subtlety. The effect was to make interpretation *even* more difficult and it seemed likely that before entering regulations into a computer program or database, a method for rigorous pre-analysis would be needed.

1.1.6 The opportunity

It was realised that it would be impractical to research this problem across several different types of regulations. In 1985, the Department of the Environment introduced an entirely new format for the building regulations entitled "*The Building Regulations 1985*". This provided an opportunity to study the new format by taking advantage of the extra attention in a new style of regulation. The new regulations themselves were simplified in comparison with the previous version and a new type of supporting documentation was introduced.

It is normal for a great deal of attention to be focused on the interpretation and impact of new regulations when they are applied. Both sides of the industry have to understand and come to terms with the intention behind the various clauses, and numerous commentaries are published to explain awkward details. It was therefore thought opportune to try to understand more about the working of the regulatory processes using the newly introduced regulations as a basis for the study.

This dissertation then, is an enquiry into how regulations operate, focusing on the search for internal structure as the main reason for the investigation. The result is a model of the internal structure of individual regulations within *The Building Regulations 1985* using them as an exemplar.

1.1.7 The method

The investigation began with a broad enquiry into the general nature and function of regulations. This was followed by attempts to devise a structure in the form of a template for selected examples from *The Building Regulations 1985.* The resulting representation was then compared with the original. Once an initial framework had emerged it was tested against some recorded disputes to find out if the points made in contesting the case could be represented within the template. This trial and error process continued until consistent results were obtained.

1.2 THE MAIN PROPOSITIONS

This dissertation examines three aspects of the subject of regulations that are exemplified through *The Building Regulations 1985.*

1.2.1 Why building regulations are applied unevenly across the UK.

Building regulations, in common with other sets of regulations, have the problem of relating their application to particular real life situations because they are generalised statements. There is always room for doubt in deciding whether a regulation should apply and on the implications if it is found to do so. The review of the regulatory process set out in Chapter 2 describes the nature of problems experienced in the application of prescriptive rules. These are illustrated in terms of the process of building control described in Chapter 5. The many levels concerned with the application of building regulations, devolution of responsibility for applying regulations to local authorities, the stages involved in obtaining approval to building proposals, and methods of inspection, all contribute to varying standards. Furthermore new building techniques lead to uncertainty regarding the

consequences of new forms of construction.[2]

The process of application of regulations is seen to be carried out within a framework, which amplifies the interpretative difficulties that stem from:

- classifying situations which trigger the regulations
- agreeing solutions to meet the aims of the regulation.

This investigation shows that a completely dependable method of communicating the intention behind a regulation is made difficult by the inherent lack of precision within natural language. Examples are given in Chapter 6 describing the analysis of a number of disputes in which it is found that nearly 50% were caused by ambiguities or gaps in the written description of the situation causing the regulation to be invoked. This result was contrary to the writer's personal experience within the industry, which has found the main focus of disagreement being the stages involve in negotiating an acceptable proposal that meets the specific requirements of a regulation.

1.2.2 A systematic procedure for the analysis of regulations is feasible

Investigation into the structure of the building regulations has led to a method for analysing the clauses of a regulation to distinguish the elements from which it has been made. It is found that these elements perform distinct roles in the operation of the regulation and that frequently disputes can be explained in terms of gaps or ambiguities in the original form of the regulation.

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[2] During the last decade, the types of material for both construction and services and the methods of cladding buildings have increased considerably. This has produced many new problems for the designer and local authority officers, since the reliance on limited specified methods is no longer an acceptable or realistic way of dealing with modern problems. Unfortunately, neither the prescribed period for a decision nor the mechanics of approval have been adjusted to allow for these new techniques and materials. [Entwisle74, p35]

1.2.3 The procedure can be computerised providing further benefits

In Chapter 8 arguments about the feasibility of representing legislation for computer processing are explored. The conclusion reached is that although there are dangers of inaccurate representation, information produced by the rigorous examination needed to convert regulations in this manner makes the process worthwhile. A suitable method for doing this is described in Chapter 9. The result is a reusable template that can be used to represent any of regulations contained within *The Building Regulations 1985.*

It is suggested that reconstructing regulations in computer processible format can lead to a number of benefits which:

- facilitate comparative analysis leading in turn to further insight into the structure of regulations
- reduce some of the problems of construction
- support a more objective approach to determining the purpose of a regulatory clause
- make easy cases more visible because the process of analysis based on the template using the internal structure makes relevant issues easier to spot
- provide a framework for arriving at a consensus view on each of the key parts of a regulation and draw attention to any inconsistencies between different points of view.

By concentrating more attention on ensuring that regulations are well formed it should be a more auditable process to achieve a consensus regarding whether a regulation should apply in the first place, and secondly, in determining the appropriate response in terms of the constructional methods to be employed. Predicting more accurately the requirements of the local department responsible for building control should save time. Furthermore it will

be harder to arrive at incorrect logical deductions and in so doing give less scope for disagreement. Application of this approach should make it easier to predict those regulations that may give rise to difficulties in interpretation and, in addition, predict the likely outcome of any disputes in the application of the regulation.

It is important to emphasise that the use of computers is not essential for the process itself to be effective, although they greatly speed up comparison and ensure a rigorous method of analysis.

1.3 OVERVIEW OF EACH CHAPTER

1.3.1 The arguments

The fundamental propositions are made up from a number of separate threads, each of which has been developed in a separate chapter. The general topic of regulations is examined in the second chapter. In the next chapter this is put into the context of legal objections to the creation of different formats for regulation. A systems view of *The Building Regulations 1985* is presented in Chapter 4. Chapter 5 describes the nature of the building regulations and special matters of interest in the version selected for investigation. The importance of disputes is reviewed in Chapters 6 and 7. Chapter 6 gives a description of the type of disputes that arise, followed by Chapter 7, which considers possible causes.

Obstacles to the creation of computer-processible formats for regulations arise due to limitations imposed by computer programs and these are reviewed in Chapter 8. Chapter 9 presents the outcome of the research as a template that embodies the internal structure. The final chapter explores the extent to which the template has answered questions raised by the earlier chapters and describes the constraint mechanism and its significance in the application of regulations in general.

1.3.2 Chapter 2 - the nature and significance of regulations

An important starting point of this research was provided by some ideas put forward by Frederick Schauer in his book *"Playing by the Rules"*[3] on the subject of prescriptive rules, a description that includes regulations. Chapter 2 establishes a foundation for the discussion of regulations by looking at their role in general terms and in so doing identifies the main issues using concepts described in his book. The roles of generalisations, and of over- and under-inclusiveness, are outlined showing how such issues are bound up with difficulties in obtaining clear interpretations. Questions about the process of application of a rule are considered with special reference to the original justification. This issue is relevant to deciding whether in fact a rule survives when local particularisation takes place.

Differences between rules and norms are discussed to clarify their definitions and to discriminate between these two categories of phenomena and a third category, that of regulations. The role of Law in formulating regulations is also reviewed against the background of a sociological perspective in an endeavour to show where certain issues in the field of philosophy cast doubts about possible conclusions. The chapter concludes by summarising the potential for regulations to be regarded as a repository of knowledge.

1.3.3 Chapter 3 - legal considerations

This chapter considers theoretical legal complications that may arise when legal statements are converted into computer representations. It reviews the evidence for the existence of particular elements that are common to different forms of regulations and defines the likely forms of such elements and the criteria necessary for confirming their existence.

Three principal issues are presented which deal with the role of rules and case-law in influencing legal processes: the status of rules, the boundary between hard and easy cases

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[3] [Schauer91]

and the open texture of law. These matters are areas of debate in general law and they touch on the acceptability of creating alternative versions of regulations. The proposition put forward is that theoretical legal objections to processing regulations in computer processible format are, in themselves, likely to generate useful insights into regulation structure.

The chapter then discusses the possibility that representing regulations in this way can help corroborate clues found in examining the results of disputes. It also considers what circumstances may need to be allowed for when converting formal legal statements into computer representations. A description is given of the principal characteristics needed to maintain the original intention behind the legislative act that prompted the creation of a regulation. Some of these are also required from a legal standpoint. The views of several researchers in the field are discussed and compared to discover what relevance they have to questions about the existence of a consistent internal structure.

It is found that there are fundamental - and controversial - issues in general law about some of these questions, and that there are opposing points of view about the validity of creating computer representations as versions of regulations. In order that such representations can be validated, due allowance must be made to account for these considerations in a theory about internal structure.

1.3.4 Chapter 4 - regulations from a systems point of view

Having presented the view that discussions about regulations are hedged about with varying definitions and alternate meanings attached to key aspects of the subject, the next chapter puts forward a systems based model of building regulations and their environment. It considers what insights into regulation structure can be obtained from a systems view of regulations and what it can tell us about them. The aim of the model is to provide a firm basis for comparing arguments developed in later chapters and to clarify various aspects of how regulations work. In addition the model helps to label the different parts of which

regulations are composed.

The general concepts set out in the previous chapter are used in relating the external environment of regulations to internal components with reference to the building regulations. The model is based on the work of Checkland[4] using the soft system approach, which shows how the external environment of regulatory processes is related to internal attributes of regulations. This reveals a close relationship between aspects of legal and sociological systems and the building regulations.

1.3.5 Chapter 5 - The Building Regulations

Chapter 5 looks at the specific regulations on which the dissertation is focused - *The Building Regulations 1985*, discusses their role, associated legislation and similar regulations in other countries. Where appropriate, reference is made to the systems model developed in the previous chapter.

The history of the building regulations, their relationship with other legislation and to similar regulations in other countries is described. These themes are used to show how styles of regulations can vary, and to assess which features may need to be present in a representation of internal structure. A sample clause is examined under the headings of the principal components of the systems model, providing a prelude to the next two chapters dealing with information obtained from problems experienced in the application of regulations.

1.3.6 Chapter 6 - problems in the application of regulations

Chapters 6 and 7 look at problems with regulations and their causes in order to ascertain what information about internal structure of regulations may be obtained from documented disputes.

Chapter 6 begins by describing examples of disputes and the various forms they take, how they are situated in the systems model and whether there is a relationship between the format and the effectiveness of a regulation. It looks at examples of disagreements about the application of regulations and assesses the kinds of information relevant to internal structural issues which disputes can generate.

The chapter argues that information produced by the outcome of documented disputes can be used to tell us more about the nature of internal structure of regulations. The location of disputes within the systems model is discussed to assist in assessing the significance of such information. Examples from *The Building Regulations 1985* are described to show the types of information which can be obtained in this way.

1.3.7 Chapter 7 - the causes of difficulties with regulations

Chapter 7 continues looking at the theme of disputes by considering how much information is obtained about the identity of principal components within a regulation by examining the causes of problems underlying the disputes previously described. It is found that an extra level of detail is added and that the roots of difficulties, in the target sample of disputes, lie in discrete areas. These are: where there is a gap in the specification of the situation which triggered the application of the regulation; or where there is some omission in the description of the conditions to be observed when complying.

This approach gives a firmer foundation for interpreting information obtained from dispute analysis and improves the potential for representation. The results show that representations must account for generalisation, entrenchment and over- or under-inclusiveness to build a model that can account for obstacles to straightforward interpretation.

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[4] [Checkland91]

1.3.8 Chapter 8 - representational complications using Prolog

Having examined the legal obstacles to computer representation of regulations in Chapter 3, this chapter looks at complications caused by the process of translating regulations into various formats.

A description is given of the salient points found by the investigation process from initial attempts at modelling a regulation through to a final data structure and program. The main obstacles are shown as: difficulties in obtaining exact meaning for nouns; representing the presence of generalisations; and depicting entrenchments contained in a regulation's wording. The main factors that have emerged from comparing the various forms of representation are summarised, to show the respective advantages and disadvantages of different methods. The method selected uses Prolog 'frames' which are fully described. The benefits obtained from this technique are applied to illustrate some of the particular problems created by other ways of storing regulations in computers.

The chapter concludes with a specification for a simple format for computer processing developed in the subsequent chapter.

1.3.9 Chapter 9 - using Prolog to build frames for regulations

In this chapter, the preferred frame format is used to demonstrate the proposition that certain regulations have an internal structure. It shows that the structure is consistent within selected regulations in *The Building Regulations 1985* and is not dependent on the form of language used. It is proposed that this is true for all clauses of The Building Regulations 1985.

The application of the internal structure is shown to be a productive way of viewing regulations. An additional advantage is that it creates a means of sharply focusing on the real loci of disputes.

The final version of the frame structure representing regulations and the process of analysis

is described, and backed up by Appendix A which gives further worked examples to illustrate how the model has been applied to a representative range of building regulations.

Examples of output from the use of the programme are given in Appendix C and a commented version of the full programme in Appendix D.

1.3.10 Chapter 10 - conclusions

Chapter 10 reviews the main issues arising out of the investigation, summarises the contribution to knowledge, and the findings of the research. It considers why the question of whether regulations have an internal structure is worth investigating and how it became established that the study was finished.

This chapter recapitulates the main arguments and emphasises the special importance of the existence of 'constraints' by referring to their role in control systems. The main types of constraint that occur in regulations are defined. It is suggested that an important outcome of this investigation into regulation structure is that more attention should be given to the role of constraints. This is of special importance because the function of constraints has recently become a topic of interest within the wider areas of information theory and computer science. Two aspects of this growing awareness of the existence of constraints that particularly relate to this dissertation are Constraint Logic Programming and the significance of constraints as part of Systems Theory.

Issues raised by earlier chapters are reviewed in the context of the results described in the previous chapter. Weaknesses in the arguments are reviewed and suggestions offered for further research.

The final representation of the internal structure is composed of a hierarchy of parts, and throughout the dissertation each of the terms shown in the following diagram is used in a consistent manner.

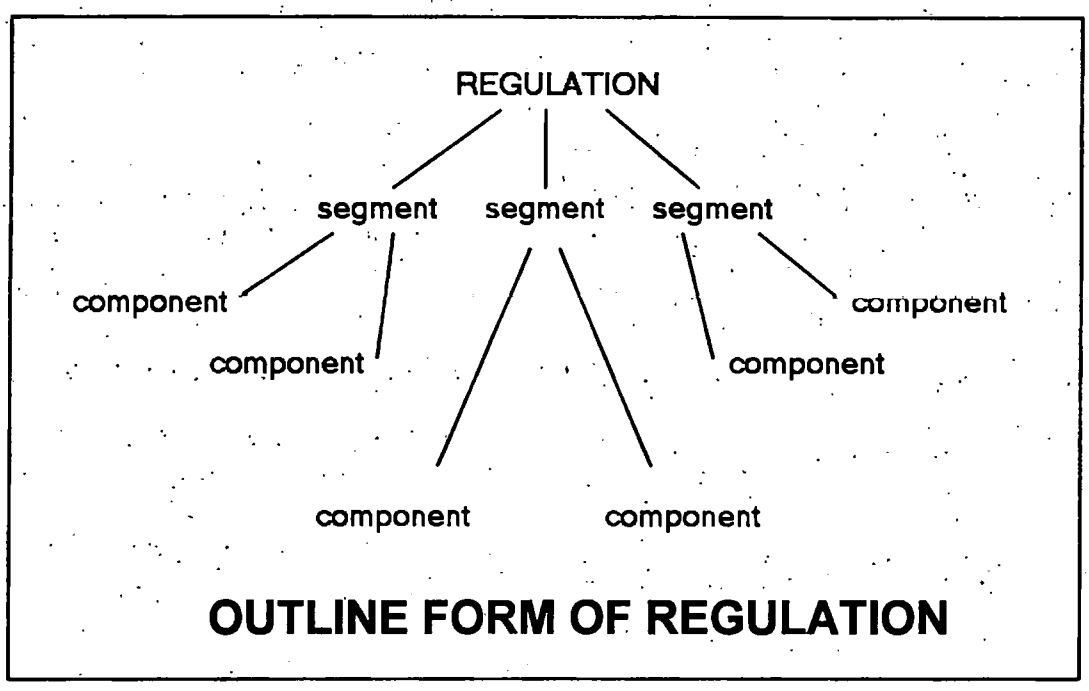

FIGURE 1.1

To discriminate between the general domain of building regulations and the specific document that is the exemplar for this thesis, the convention is adopted that the latter is rendered in italics e.g. *The Building Regulations 1985.*

CHAPTER 2 NATURE AND SIGNIFICANCE OF REGULATIONS

Abstract

This chapter describes the background and reasons for the investigation because the subject is not straightforward. The main issues are identified using a resume of the book "Playing by the Rules" by Frederick Schauer on the subject of rules. The main differences between rules and norms are discussed and the implications for the definition of regulations.

The role of Law in forming regulations and the implications for the Building Regulations are considered and the sociological perspective is reviewed together with some comments on the philosophical background.

The chapter concludes by summarising the significance of regulations and possible function in acting as a repository of knowledge.

2.1 INTRODUCTION

2.1.1 Chapter outline

This chapter sets out the principal characteristics of regulations in so far as they are pertinent to the theme of the dissertation. It provides a background against which to begin considering aspects of regulation structure. The overall picture is complex because the process by which behavioural limits are applied crosses the boundaries of several disciplines.

The chapter begins with a general view of regulations and in enquiring how they differ from broader categories of rules and normative structures. A framework proposed by Frederick Schauer is used to identify the main issues about regulations, which have a bearing on this dissertation, and to provide definitions that underpin the bulk of the investigation[1]. He summarises the main issues setting out the essential details of the subject by identifying the main influences at work. In this way he shows how generalisations become entrenched in forming prescriptive rules so that they can exert normative pressure. He argues that the main features of regulative rules are that they are based upon inevitable generalisations that have become entrenched in order to exert force within society. He surveys the main contributions made by rules in terms of reliance, efficiency, stability, and allocation of power and co-ordination of the community.

This chapter continues by: relating the place of regulations to the legal system; the role which they play in society; processes involved in formulating them; and how they make their contribution to the decision-making process. It compares the work of Schauer with general notions of norms, knowledge, and innovation as far as they relate to regulations and considers what they may tell us about internal structure. The views of other writers on the subject of rules from the perspective of the legal system, sociology and philosophy are mentioned with the aim of setting the subject of regulations in the context of adjacent subject areas.

For the purposes of this study regulations are defined *as written documents arising out of legal statute* and thus some reference is needed to the workings of the legal system. By narrowing the focus in this way we can exclude an extensive variety of regulations such as those provided for clubs, sporting activities, and those set up by commercial organisations. Although they may share most, if not all, the characteristics of the specified sub-set of

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[1] [Schauer91]

regulations, they are subject to less predictable influences having usually been defined for a specific purpose which may not correspond with formal legal processes.[2]

Finally we examine the sociological perspective of regulations, in an attempt to connect the background created by the way legal systems structure the society of which they are part, to processes which are the concern of sociology. Although the sociological concerns are, in the main, outside the scope of this study, some of the arguments put forward by sociological commentators can help to sharpen our awareness of the role of regulations. They have an increasing influence in our complex society and involve building up constraints on a wide variety of technical activities and new forms of behaviour. These extend decisions to declare regulations into the political arena and also areas where they may be used for commercial influence.

In addition to the foregoing topics, there is also a philosophical dimension to the interpretation of regulations which is related to issues of meaning and language. Although this subject is outside the scope of this present study, a number of points need to be acknowledged in order to indicate how they relate to the subject matter of this dissertation.

The concluding section of this chapter brings together the various threads of arguments which have been described, with emphasis on the extent to which they represent an identifiable body of empirical knowledge and the way in which they set boundaries for the decision-making process. It concludes by considering briefly the extent to which they can be said to be a repository of knowledge.

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2 Writers, such as Dworkin [Dworkin86], and Leith [Leith86/1-2], on the subject of the law are generally more concerned with questions of legal validity, interpreting case law and looking for a coherence within legal practice rather than the narrower topic of the function of regulations. However, this is the environment within which regulations are located, so that many of the arguments have some bearing on the role and performance of regulations.

2.2 DEFINITION OF REGULATIONS

2.2.1 Introduction

At the beginning of his book,[3] Schauer defines his subject as the nature of prescriptive rules and his central theme as the importance of seeing rules as "crude probabilistic generalisations". Initially he describes the different sorts of rules by discriminating between regulative, mandatory, constitutive and general laws, making it clear that he speaks to types not particular examples. He then deals with rules and generalisation and follows it with an extensive analysis of ways in which rules inevitably become entrenched. Commenting on the importance of rules in decision making by generalisation, he examines the reasons for rules and how they interact with the law. The significance of his work in relation to this study is that Schauer is writing about the forces at work when regulations are created and applied in everyday life.

2.2.2 Rule types

At the outset Schauer makes it clear that he is dealing with a narrow class of regulative rules and not about every entity to which people attach the word "rule". He goes on to distinguish between descriptive rules and prescriptive rules (which include regulative rules). Descriptive rules are exemplified by reference to laws of gravity and principles of physics, which are used to describe and explain the world rather than alter it. Prescriptive rules are presented as having a normative semantic content used to guide, control or change the behaviour of agents with decision-making capacities. His approach conveniently matches the distinctions considered necessary, by the writer, to tackle questions about the make-up of regulations.

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[3] [Schauer91, p.xv]

The following diagram relies on his definitions of the different classes of prescriptive rules and shows the position of regulative rules in this setting.

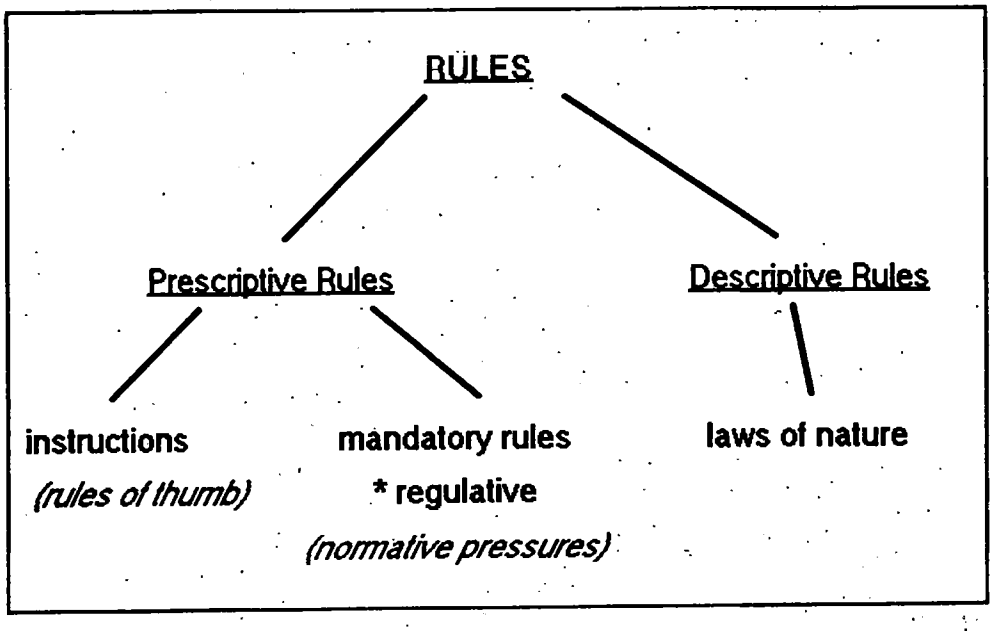

FIGURE 2.1

He raises some helpful questions at the outset[4] "are rules linguistic entities or behavioural phenomena? Is the force of a rule located in its meaning, or in its sanctions, or in the attitude of its addressees?" He goes on to state "...for decision according to rules is but one among many sorts of decision making" and points out that governments could control behaviour by delegating discretion to subordinate government officials using particularised judgement. He suggests that much of the mechanism we call the legal system need not operate according to the conception of rules elaborated in his book. This point emphasises his assumption that rule-governed decision making forms a subset of legal decision making rather than being congruent with it.

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[4] [ibid. p.10]

2.2.3 Generalisation

A central issue raised by Schauer is that of the fundamental nature of generalisations in the make up of rules. However, before dealing with generalisations in detail, he makes the important distinction that rules speak to types and not to particulars. He emphasises that unless the rule addresses multiple instances or prescribes for more than one action, it is wrong to use the word "rule". His position is that any rule must be based upon a generalisation involving the process of choice in selecting appropriate properties to focus on. He describes the importance of language in creating numerous generalisation options, emphasising that any generalisation is at the same time, both selectively inclusive and exclusive.

This issue is of great significance when dealing with questions of interpretation, as will be shown in a later chapter (7.4.2), and may be an underlying cause of many problems in applying regulations. Also of significance to this investigation, because it touches on the specification of conditions triggering regulations, is his assertion[5] that "suppression is important precisely because it is not negation". He gives an example by pointing out that to say 'the Queen Elizabeth is a ship' suppresses that fact that it has ballrooms but does not deny their existence. His description of probabilistic generalisations echoes much of current discussion about risk theory[6] - the way in which authorities assess the importance of different risk activities and consequent implications for control measures that may be adopted.

2.2.4 Entrenchment

Schauer illustrates the way in which generalisations become *entrenched* by describing three

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[5] [ibid. p.22]

[6] "...the necessarily risk-averse aspect of rule-based decision making" [ibid. p.155]

types of ill-fitted generalisation:

1. a probabilistically warranted generalisation is incorrect on a particular occasion
2. a supposedly universal generalisation turns out not be universal
3. a suppressed property is now germane.

He calls these "recalcitrant experiences", i.e. events which call into question generalisations which are acceptable under most circumstances.[7] Having explored the issues behind entrenchment, he describes the pressure on generalisations when a rule is applied to a particular case, illustrating with numerous examples how argument and counter-arguments can be justified by uncovering succeeding levels of a generalisation. Entrenchment has important implications for the notion of internal structure because it emphasises connection between a written regulation and the process of general acceptance of what it means, equivalent in Dworkin's terms to the difference between the letter of the law and "real" law.[8]

When talking about entrenchment Schauer argues that a generalisation is both a simplification and a specification[9]; he points out the importance of the background justification of a rule and offers a view of a rule as the instantiation of its background justification. An important part of his argument depends upon the perceived strength and weakness of links between original justification and the final version of the rule. This has relevance to discussions about 'purpose' which, as we will see, is one of the more difficult aspects to be certain about in discussion of any regulation. The extent to which a

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[7] It is interesting to note that these are examples of illustrating the existence of something by pointing out what happens when it fails. This is a device used to identify elements of a regulation and described in chapter 6 below.

[8] [Dworkin86, p.17]

[9] A generalisation is a simplification because it "narrows the array of facts that would otherwise indicate the applicability of the justification" and a specification because generalisations "specify the result that will usually be obtained from direct application of their justifications". [Schauer91, p.53]

justification becomes entrenched in a rule and is then challenged invokes a wide range of questions about how a rule is applied in a given situation. Schauer points to this as one of the ways of testing whether a rule has a real existence, using it as a key benchmark for performance.

He extends this debate into the area of language by drawing the parallel between 'acontextual meaning'; language that is not totally determined by circumstances,[10] and situations where the language employed depends entirely on the circumstances of a particular occasion. The extent to which language carries meaning independent of context is a subtle point, but is often at the heart of questions about exact intentions behind a regulation.

In his work Schauer refers to Wittgenstein and other writers on the subject of language and law to support his argument[11] that "entrenchment is what enables a rule to resist the impulse to modify in the face of recalcitrant experiences". He makes the point that rules and their formulations are different and states "it is the meaning of the formulation which is capable of being entrenched". Much of his argument depends upon assessing views about the way in which language is used and is supported by reference to a number of specialist writers on the subject. Many of the questions surrounding entrenchment help us to understand why the eventual rule, either written or as applied, differs inevitably from the original justification for making it. He says "Rules get interesting however when we are in the region of under or over-inclusiveness, when a particular application of a rule generates a result divergent from that which would have been generated by direct application by the

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10 "...the *semantic autonomy* of language, the ability of symbols – words, phrases, sentences, paragraphs - to carry meaning independent of the communicative goals on particular occasions of the users of those symbols." [ibid. p.55]

11 [ibid. p.62]

rule's justification". He goes on later to say; "I want to locate a rule not so much in its canonical formulation as in its entrenched meaning".[12]

2.2.5 Decision-making

Schauer deals with some complex questions about decision-making, their relationship with recalcitrant experiences, and the vital contribution of entrenchment. He argues that decision according to rule is decision according to an entrenched generalisation, referring to the principle of utility and the concept of act utilitarianism in so far as they suggest that an "act-based decision making procedure is extensionally equivalent to one based on generalisations from fully described acts".[13]

At this point his arguments about the various facets of rules are at their most detailed with very fine differences being compared. His arguments draw attention to the delicate balance which exists in the ways in which rules work between the generalised description of acts to be controlled and focusing so precisely on features of an act that it becomes too narrowly defined. The subtlety of these differences is conveyed by his assertion that: "a strategy of generalisation proceeding from a complete description of the precipitating act is only one of two approaches to generalisation, the other, generalising from a less than complete description of the precipitating act, is not plausibly extensionally equivalent to a decision procedure focusing only on the precipitating act itself".[14] This assertion draws attention to the process of enforcement by proposing that if a rule can be modified in application it weakens its force even to the extent of disappearing altogether if applied too loosely. He asks the question: - can a rule be modified at the moment of justification remarking that

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[12] [ibid. p.72]

[13] [ibid. p.79]

[14] [ibid. p.80]

"the absence of continuous mobility, rather than the presence of limited specificity is the feature which is both a necessary and a sufficient condition for the existence of rule-based decision-making".[15]

The following quotation summarises his arguments:

> "We thus see rules as essentially frustrating, exercising their influence by getting in the way. They impede access to those facts that would otherwise, under a given theory of justification, be relevant to making the decision, and they interpose facts that would otherwise be irrelevant. Consequently, the effect of rules is either to truncate or to bloat the array of decision-making facts, and to do so in a way that is likely to appear artificial. A rule establishing a speed limit of 55 miles per hour, in order to serve the justification of reducing unsafe driving, presumptively eliminated from consideration those facts that would otherwise be relevant in the determination of unsafeness. The dryness of the road, for example, is relevant to determining safety but irrelevant in determining speed. Similarly, the rule prohibiting smoking prior to toasting the Queen is presumably based on the justification of refraining from interfering with the dining enjoyment of others. Many factors might be relevant to determining whether a particular act of smoking served that justification (Had everyone finished eating? Were there non-smokers at the table?), but the rule precludes consideration of those factors, substituting instead an exclusive focus on the occurrence of the toast".[16]

The importance of this quotation is the way in which it emphasises the relationship between the way in which situations are described and the effects on the subtle nature of the way rules work. Schauer talks about the question of ignoring speed limits when rushing an injured person to hospital as exemplifying the dilemma that may be used to justify ignoring or bending a rule. His example does however raise an alternative interpretation; that the person "rejecting the rule" might be taking into account a generally accepted notion of over- or under-inclusiveness rather than simply disregarding the rule altogether. The driver might perhaps be taking the view that the speed limit became more elastic due to the urgency of the situation.

Having drawn attention to so many factors which affect the way in which rules work,

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[15] [ibid. p.83]

[16] [ibid. p. 87]

Schauer then offers the view that rules emerge as necessarily sub-optimal and asks whether this has implications for the way in which we think about their role in decision-making. He describes two features of rules that have special importance for this dissertation: the degree of variation in their strength, and their usual situation within hierarchical rule systems, which establish among other things their internal validity within those systems.

2.2.6 Purpose of rules

Schauer considers the question of how much an individual should take existence of rules as a basis for actions. Emphasising the role of sanctions, he suggests that: "from the standpoint of the subject therefore the authority of the rule appears least rational when the subject is asked, solely because of the existence of the rule, to perform an act the subject is convinced ought not to be performed, or not to perform an act the subject is convinced ought to be performed".[17] On this basis he comes to the conclusion that when there is disagreement between authority and the subject "the rational authority is led to attempt to require obedience just as the rational subject is led to disobey".[18]

The explanations he gives as the reasons for having rules come under four headings:

1 fairness
2 reliance
3 efficiency
4 stability.

He raises several issues that are pertinent to the present research in each of these. Under the heading of *fairness* he points out that rules have to ignore subtle differences between

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[17] [ibid. p.129]

[18] [ibid. p.131]

individual situations which are often taken as grounds for complaining that a particular rule is unfair.

From the point of view of *reliance* he draws attention to the clarity of the rule and the implicit paradox that "the frequency of sub-optimal decisions, therefore, will be highest in those cases in which the predictability advantages of rule-based decision-making are likely to be the largest". This again raises the subject of risk and issues of probability.

In the case of *efficiency* Schauer emphasises that rules "allocate the limited decisional resources of individual decision-makers, focusing their concentration on the presence or absence of some facts allowing them to 'relax' with respect to others." This argument serves to emphasise that the accessibility of the essential parts of a regulation may have a direct bearing on its efficiency. In this section he emphasises the importance of operative facts in determining whether a rule is applicable, coming back again to the point that rules truncate the array of facts to be considered. He suggests that there has to be a balance in the number of factors which have to be taken into account in order to avoid what he describes as "computational error".

In discussing the plausibility of arguments for *stability* he describes the arguments for dampening variants as a good to be pursued in their own right. He also subsequently raises some interesting ideas regarding the way in which rules have a time-shifting effect in carrying forward decisions to the future.

2.2.7 The law

Schauer discusses the question of precedent, suggesting that an argument from precedent operates substantially like an argument from rule. However, where there is only a previous decision and no rule formulation the source of the precedent is obscure and consequently the manner in which the previous decision constrains becomes problematic. He explains this by pointing out that the first case is a particularisation containing no generalisation,

whereas in second and subsequent cases, decisions are made which create a generalisation at that time. He comments that defining the operative facts of a typical case make resolving questions of generalisation in a particular case more difficult, thus pointing to one of the obstacles in the categorisation of rules for incorporation into computer programs. He links his arguments to various opinions about the way in which the law operates and to theories such as presumptive positivism[19] used to explain legal process. His arguments about problems of precedent can be used to explain many of the difficulties, which arise during conversion of generalisations, and are embodied in operative facts into computer programs. In dealing with the interpretation of rules Schauer discusses the issue of *hard cases* (a topic which will come up again), pointing out that if the issue of hard cases is central to interpretation, then the problem of definition of a hard case is in itself problematic. He comments that strict interpretation of rules can lead to absurd consequences and that recourse to original intent cannot plausibly be taken as a linguistic necessity.

2.3 RULES AND NORMS

Having used the work by Schauer to describe the background to discussions of rules, and more especially prescriptive rules or regulations we can now consider useful comparisons that can be made between rules and the more general forms of regulations. This section of the chapter expands on distinctions made by Schauer between the various types of rules and norms. As we have seen regulations inherit many of the characteristics of rules and one of the conclusions of this dissertation is that internal structure of regulations may not differ greatly from any internal structure which may be contained within more general

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[19] Schauer's detailed discussion of this concept refers to the operation of constraints as "commonly presumptive rather than absolute" [ibid. p.196-206]

kinds of rule. The distinction between rules and norms depends vary largely on the context in which the two words are being used. Both are general terms and a great deal has been written about the role of the norms which suggests that the similarities and differences to regulations may be informative.

2.3.1 Rules and laws

The word "rule" is derived from the Latin "regula", a straight edge. It is a general term applied to controls of one sort or another; authoritative directive, exercise of control, customary procedure, an order by a court, or prescribed method of procedure. The term is also attached to a wide range of meanings associated with the idea of a straight edge for delineating boundaries. The point has already been made, but is worth emphasising again, that laws of nature are descriptive in nature although the word rule is often used in the sense of descriptive principles. This category of laws consists of those, which are known to be widely true, such as the fact that metal expands when it is heated. They are also the type of rule used in "production" rules for knowledge representation purposes and are of a classificatory nature. 'If it flies, then it is a bird' is a format used to assemble knowledge about a given topic. The 'if-then' format is similar to the generally accepted structure of legal rules and regulations that will be considered more fully later. This way of using rules sometimes leads to the view that rules are a way of structuring reality.

The kinds of rules that are the subject of the present study are prescriptive; their main functions are to govern behaviour by limiting or changing the conduct of agents with decision-making capabilities, within rule-defined sets of procedure.

2.3.2 Norms

Norms share many of the features of rules. Kelson in *The General Theory of Norms* states "People speak of norms of morality and law as prescriptions concerning people's behaviour

towards each other, and in so doing they mean to express the idea that what we call 'morality' or 'law' consists of norms, is an aggregate or system of norms".[20] He appears to regard norms as if they were an evolutionary consequence of a developed society, being a phenomenon responsible for constraining behaviour, but less directly stemming from a conscious act. In this way they differ from regulations which have been drafted and issued in written form. Kelson draws attention to the way which norms are created not only by legislation but also by way of custom arising from the practice of the judiciary, as if newly-created norms came from formalising that which has already received general acceptance. In making this suggestion he makes reference to Esser's transformation theory: " a process by which a principle becomes positive law".[21] Bartsch states: "roughly, we can say that norms are the social reality of correctness notion; the correctness notions exist in a community by being the contents of the norms" [22]

Propositions which state what "ought " to be done are referred to as normative and the content of the proposition is a norm. We are familiar with norms in everyday life because they describe the various standards that we accept for the conduct of our social activities. The key factor in such propositions is that they imply a constraint upon our actions - usually in the form of negative pressures advising us what we cannot do. To this extent they have a similarity with regulations and because they bear upon small-scale activities such as wearing a hat in church they compare with individual clauses of a regulation. The main difference between social norms and regulations is the absence of a defined sanction and the absence of written definitions of norms. Although sanctions, often quite fierce social penalties, maybe put into effect by those offended by the lack of observance of a

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[20] [Kelsen91, p.1]

[21] [ibid. p.119]

[22] [Bartsch87, p.4]

norm, there is a degree of flexibility which places their influence outside regulations as defined for this dissertation.

2.3.3 Regulations

From what has been said it seems reasonable to suggest that norms are part of the more general group of rules with an emphasis on their being a natural development out of the growth of society. However for the subject of this dissertation we shall distinguish between regulations that are written, derived from law and superior legislation, and norms, rules, and general law all of which are more diffuse and less amenable, to the kind of detailed analysis proposed. However one difficulty which stems from this distinction is that most writers, for example Twining and Miers in their book "How to do Things with Rules", use the term 'rules' in a general sense, rather than as regulations which are part of a legal system.[23] Regulations share many characteristics with formal legislation, and also with the more general class of rules and normative structures, all of which play some part in the environment in which regulations take effect. The distinguishing features relevant to this investigation are that regulations are created for a purpose, and that they exist in an environment which is subject to change. Furthermore, they may be positive or negative, defining respectively what must be, or what must not be, done; and that they are always assumed to imply some sort of sanction.

Three alternative sociological paradigms will be referred to later, each sharing a view of the role of norms as central in structuring and controlling social activities in most of the commonly accepted paradigms. One model regards the common values and norms embodied in the culture or subculture as being its institutions. Another view regards the normative structure as a framework in which decisions to act are made. A third, the

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[23] [Twining/Miers91]

behavioural paradigm, suggests society is controlled by reinforcement and conditioning to conform to norms. From consideration of these models, norms and social mores appear to be among the least tangible and most dynamic part of the fabric that holds societies together.[24]

In this study regulations are considered to be less deeply embedded because of their more tangible form, and because they are more directly accessible for study and direct alteration. It is therefore evident how closely these topics are connected to issues raised by Schauer in his book referred to above.

2.4 LAW AND CONSTRAINT SYSTEMS

Regulations are the principal mechanism by which government limits the range of acceptable individual and corporate behaviour in narrow domains of interest. They can be regarded as the most direct and least controversial way in which people are constrained by legislation because they operate within specific, often technical domains employing a limited specialised vocabulary. As such, regulations have to achieve the aims of the authority creating them and do this within the framework of the legal system authorising their existence.

2.4.1 Influence of the legal system

Lloyd[25] expresses the view that, in most societies, the civilising process can be associated with the gradual development of a system of formal rules for the conduct of people and organisations. Since ancient times there has been a continuous search for higher or ideal

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[24] "Refusal to conform to the norms leading to a weaking of the bonds that tie the individual to the social organisation" [Cotterrell84, p33 and 86/7]. See also section 2.5.2 below.

[25] [Lloyd87]

laws to explain the need for, or justify the existence of, laws to control daily life. Questions of justice - the idea of fairness, the test of truth, the issue of meaning - exist within a general debate about whether it is necessary to restrain man's activities or to allow greater freedom to encourage benign behaviour under the right conditions. The growth of regulations and evolution of law in most societies has been influenced by ties with religion, which may explain why distinct legal traditions have evolved in different countries.

The contrast between Civil and Common law may have a direct bearing on the way in which regulations are created under each system. Legal systems within one culture have structural features that differentiate them from the legal systems of other cultures. In contrast to English legal methods, continental jurists have an emphasis on substantive law with its great reliance on procedural rules.[26] American law is regarded without hesitation as a member of the Common Law family but it differs from the English model because of the differences between federal and unitary systems. However the English and American legal systems have a great deal more in common because of the importance of case law, than for example Chinese law, which takes a more arbitrational stance. The way in which regulations interact with each of their cultural and legal environments may lead to variations in their internal structure because of differences in the surrounding mechanisms. These issues are not addressed in this dissertation because it looks only at building regulations in the United Kingdom. Issues raised about the aims of the legal system responsible for a set of regulations are outside the scope of this study. Nevertheless it may be necessary to allow for the influence of such aims,[27] when considering whether the required degree of control is being achieved in the context of the performance of regulations as part of a legal policy.

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26 [ibid.]

27 Which may be manifested by implicit generalisations within regulations.

In his book "The Ideas of Law" Lloyd sets out eleven themes defining the subject of law; necessity, society, custom, morality, force, judicial process, natural law, legal positivism, justice, freedom, international law.[28] Running through each of these themes are questions of good versus evil, law as a restraint on the dark side of man and whether law is made by divine inspiration or created by man's own institutions. One of the key tests is establishing the authority of a law or regulation, and he points out that such debates can be traced back to theological arguments because of the close links between law and religion. Lloyd refers to the writings of Augustine who saw state law and coercion as part of divine order restraining human vices due to sin. Because there has always been some dispute about the need for restraining laws, connected with philosophical questions about individual rights to act without restraint, Lloyd comes to the conclusion that in even the simplest form of society, some system of rules is inevitable.

The acceptance or otherwise by society of the need for law is part of the context in which laws and regulations are framed. In the case of regulations however, they are usually created in response to some directly perceived need created by pragmatic issues such as particular events linked to public safety. As such they are less concerned with broader issues of philosophy, theology or politics. Nevertheless from time to time regulations may be challenged on the sort of doctrinal questions which are threaded through all of them. For example, the issue of force and the involvement of a police officer in exacting obedience under threat of shooting or violence raises the question of how it is that some persons are entitled to require the obedience of someone else, and whether law can exist without the possibility of backing it up with force. It is generally argued that people obey the law not just because they are constrained to do so by force, but because they consent or

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[28] [ibid.]

acquiesce in its operation. It is taken that it is this consent, rather than any threat of force, which enables the legal system to work. This explanation relies upon a co-operative view of society based on a social contract between its members who thereby agree to submit to law and government.

Compliance with regulations is therefore a function of the attitude of a society to the legal environment in which it exists and is usually taken for granted in deciding the enforcement techniques to be adopted. In a rapidly changing social environment the role of a judiciary in interpreting the law and taking into account new conditions in order to bring the law into line with the needs of a modern community has a bearing on what may have been the original purpose of a regulation. The judiciary may also influence the limits defined by interpretation in order to achieve the objective of the regulation. As new ways of living arise, the boundaries set earlier may become irrelevant or be seen as absurd. The way in which judges make decisions under these circumstances is a factor in the formation of the regulation. Lloyd points out the tendency of human minds to want to treat similar cases in the same way as a possible justification for rules. He suggests that this tendency is perhaps used to conceal the making of new laws by judges who may wish to play down any element of choice in their judgements. A key difference between general law and the regulations it creates is that regulations are less concerned with moral issues and may be adapted to respond to new technical demands with less sensitivity.

2.4.2 Regulations in English law

In this country, Parliament is the originator of statute law and through its legislative powers is able to give law-making responsibilities to other bodies, such as local authorities and Government Departments. Holland and Webb describe the main features of the position of regulations in English Law stemming from three primary sources: Parliament, the Courts, and the European Economic Community:

> "This results in a form of law that is referred to as delegated, or secondary legislation which is mostly published as 'statutory instruments' also referred to as 'Regulations'. Delegation always requires the express authority of an Act of Parliament, which, in respect of any delegated legislation created under its authority, is the parent Act. The parent Act will not only give authority to the process of delegation, but also sets the parameters of the delegated power. Sometimes these will be extremely wide and generalised, for example where an Act provides that 'the Secretary of State may make such regulations as he sees fit' but they can also be highly detailed and specific. For example s.52(1) of the Social Security Act 1986 requires eighteen paragraphs and six sub-paragraphs to specify the powers available to regulate claims and payments of benefit".[29]

2.4.3 The Building Regulations

The Building Regulations are an example of a body of regulations, and they will be described in more detail in chapter 4. The particular feature to recognise at this point is that they set out to achieve certain objectives regarding the health and safety of persons within buildings. Such issues themselves are not likely to be controversial within British society; but the regulations designed to achieve this are frequently challenged on points of detail about how such principles are applied. For example, the central regulation in *The Building Regulations 1985*, upon which all subsequent parts depend, states:

> "Building work shall be carried out so that - (a) it complies with the relevant requirements contained in schedules 1 and 2, and (b) the method of complying with any such requirement does not result in the failure of any part of the building work to comply with another such requirement. "

This suggests the following questions:

- Does this differ in some way from other written statements that are not regulations?
- Is it different in any way from say, the rules of tennis?
- How does it interact with other regulation clauses within the same body of regulations?
- What is the parent legislation from which it is derived?

These questions will be considered in more detail in the section dealing with the Building Regulations but are mentioned here in order to underscore the relation between regulations

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[29] [Holland and Webb92, p3/4]

and the legal environment in which they sit. It is also worth pointing out that words such as "relevant" lead to all sorts of further questions sometimes satisfied by other written documents - such as the "Approved Documents" in the case of *The Building Regulations 1985* and sometimes by reference to commonly accepted good practice.

2.4.4 Designing regulations

A further aspect of regulations, which may throw some light on their internal structure, is the many processes involved in their drafting and production. Garnham Wright when writing about designing regulations for the construction industry said "for the type of control used in the UK, where regulations are an integral part of the penal code relying on the courts of law, and are enforced by local authorities using some form of inspectorate there are five main rules which need to be followed if difficulties are to be avoided". [30]

His list can be summarised as follows

1. Properly related to the enabling powers of the act requiring them to be made. (Reminding us of the link with the enabling legislation).
2. Requirements clearly stated. (The importance of each part of the written regulation).
3. Requirements within the technical competence of the construction industry. (Inferring the potentially specialised nature of language)
4. Requirements should not set excessively costly standards. (Lying outside the reference of this investigation).
5. Framed in a way which makes enforcement practical. (Referring to the need to properly relate the regulation to the enforcement procedure envisaged).

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[30] [Wright83, p.80]

2.5 SOCIOLOGICAL PERSPECTIVE

Cotterrell states: "In one sense law and sociology ..... are similar in scope yet wholly opposed in method and aims. ..... Law as a discipline is concerned with elaboration of a practical part of government through rules. Its concern is prescriptive and technical. Sociology is concerned with the scientific study of social phenomena. Its concern is explanatory and descriptive." Cotterrell goes on to emphasise, however, that both disciplines are dealing with "the whole range of significant forms of social relationship". [31]

Ritzer offers a useful commentary on different models of sociological thinking, and which refers to the function of norms by describing three alternative paradigms held at one time or other in the study of sociology.[32] These are: the social facts paradigm, the social definition paradigm and the social behaviour paradigm.

2.5.1 Social facts paradigm

Emil Durkheim is quoted as the exemplar based on his view that the basic subject matter of sociology is the 'social fact', which raises the question of whether social facts should be treated as real entities or as convenient representations. Blau (1960) drew attention to two types of social facts. The first being social structures - "the networks of social relations in which processes of social interaction have become organised and through which social positions of individuals and sub-groups become differentiated. The second described as social institutions - "the common values and norms embodied in a culture or sub-culture". Some argue that these should be treated as if they are real, and others that they are real entities. The 'social factist' focuses on the nature of these structures, the institutions, and their inter-relationships seeing behaviour and social definitions more or less determined by

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[31] [Cotterrell84, p.5]

[32] [Ritzer88]

social structures and institutions.

There are two main theories deriving from this model; structural functional theory, and conflict theory. The first of these regards social facts as inter-related and is essentially a systems view of society. Attitudes differ about the positive and negative effects of the interaction between these parts. For example, Gans explores the various functions that poverty has in society under four headings; economic, social, cultural, and political, emphasising the point that if we want to do away with poverty we have to find alternatives to the variety of functions performed by the poor.

Conflict theory, on the other hand, tends to emphasise disorder among social facts or the situation that coercive forces within society maintain order. Society is projected as involving dissension and conflict at every point contributing to disintegration and change. Functionalists tend to see society as being held together informally by norms, values, and a common morality whilst conflict theorists see the order stemming from the coercion of society by members at the top imposing rules to suit their self-interest.

2.5.2 Social definition paradigm

To explain this model Ritzer selects Max Weber's work on social action who defined it as all human behaviour when and insofar as the acting individual attaches a subjective meaning to the action. From this point of view the central theme becomes the way in which individuals define their social situations and the effect of this definition on ensuing action. Man is regarded as the active creator of his social reality and the subject matter is not social facts but the way in which people define so-called social phenomena. This approach takes the premise that if people define things as real they will be real in their effects.

This model has given rise to various theories:

- action theory, in which men act to achieve goals which are limited on the one hand by circumstance and on the other by the standard rules or moral principles invoked
- symbolic interactionism (John Dewey) in which the actions of human beings are based on meaning attached to others' actions on the basis that social facts are just the framework within which symbolic interaction takes place
- phenomenology (Hussel, Schutz and Garfinkel) in which social intercourse is regarded as depending on the knowledge of rules which are shared yet experienced subjectively.

Order and meaning are considered to be imposed on an empirical world by man, and Ritzer[33] refers to Goffman as alluding to the power to maintain or destroy the social world of others -

> "...rules for the management of engrossment appear to be an insubstantial element of social life a matter of courtesy and etiquette. But it is to these flimsy rules and not to the unshaken character of the external world that we owe our unshaken sense of realities. To be at ease in a situation is to be properly subject to those rules entranced by the meanings they generate and stabilise; to be ill at ease means that is ungrasped by immediate reality and that one loosens the grasp that others have to it. To be awkward or unkempt, to talk or move wrongly is to be a dangerous giant a destroyer of worlds. As every psychotic and comic ought to know any accurately improper move can poke through the thin sleeve of immediate reality".

2.5.3 Social behaviour paradigm

Ritzer[34] exemplifies the third paradigm by the work of the psychologist, B. F. Skinner. The behaviourist seeks to understand, predict, and even determine the behaviour of men of particular interest employing the theory that rewards elicit desirable behaviour and

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[33] [ibid.]

[34] [ibid.]

punishments inhibit undesirable behaviour. The theories, which arise out of this view of sociology, are directed towards relationships between the individual and his environment. For example, deprivation of food, sex, water, or air will serve as a potent reinforcer if withheld. Most social organisations remove or threaten to remove rewards rather than offer incentives. Socialisation is seen as an interactional process whereby an individual's behaviour is modified to conform to the rules or standards of the groups to which he belongs.

2.5.3 Comment

What do these three views of sociology suggest about the way in which regulations control and about their internal structure? One of the main features to emerge is the general acceptance of the idea that norms and rules create a multi-dimensional network affecting every aspect of our lives. They constrain how individuals interact with each other and how they are able to plan and influence their own future. Whereas rules and norms evolve gradually through the development of societies, regulations are imposed by a conscious act of a group of legislators. The legislators are however operating within the same complex normative network and can expect the regulations to carry out their intentions because of the very existence of the normative network.

There are of course many other models of social systems that have been proposed, each focusing on a particular feature such as the political system, the kinship system, or the cultural aspects of values, knowledge, beliefs, and ideologies. For most commentators, the importance of social pressures in structuring society is as the matrix that binds everything together. Regulations form a very visible example of interventionist processes within this network.

2.6 PHILOSOPHICAL VIEWPOINT

Some of the arguments put forward in the debate about the role of law in society, and the way which society is held together by normative influences, are based on philosophical ideas. Whereas philosophers debate subtleties about the meaning of reality and even the role of meaning itself, in everyday life, probably most people believe that writing something down makes its meaning clearer; even that putting statements into words will improve understanding. Consequently, regulations are regarded as authoritative statements and a reliable basis for action. From our everyday experience we know that is generally true - provided that parties in the communication process are not insisting on a high degree of precision. When a highly-accurate statement is required, subtle shades of meaning can open up extensive possibilities for disagreement, in which a great deal of attention is focused on the range of meanings which can be applied to a particular word or phrase. The paradox is that as a search begins for common elements, the detail becomes finer and differences of interpretation may become greater.

These issues will remain the subjects of philosophical conjecture, but they directly impact on our understanding of the way in which language works and the validity of our concepts of reality. We need to take into account the conjectural nature of our understanding of such matters because they are also key questions for those interpreting regulations.[35]

2.7 ROLE OF REGULATIONS IN DESIGN

Especially in the case of technical rules and regulations that are often linked to codes of practice, regulations embody significant accumulations of empirical knowledge. In the process of creating technical regulations it is usual to consult a large number of experts in

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35 The point made by Wittgenstein regarding the meaning of a common word like "games" emphasises the difficult nature of the territory we are investigating. [Sowa84]

the relevant field for their views. In theory at least, the best possible solutions for various situations are incorporated into the regulations. These represent solutions that are known to have worked in the past, are regarded as good common practice, or are considered by the drafting body as being a sound framework for an envisaged situation. Those drafting the regulations will also try to avoid creating unreasonable difficulties that would hinder the process of complying with new restrictions.

In many design methodologies an important feature of the process is establishing the boundary conditions of likely acceptable solutions. Fukuda says:

> "What should be stressed about structural design is that structures are designed based on codes standards and regulations. Structural design could, therefore, be described as a process of demonstrating and justifying that the design models and their changes comply with the requirements of the codes, standards and regulations. The primary role of codes, standards and regulations is to set constraints in the line of reasoning." [36]

He then goes on to point out that an important function of constraints is to define the search space within reasonable limits. Later in the same document he refers to the changing trend towards more open regulation "past laws and regulations are 'closed' within themselves so that the final solutions can be obtained by using them alone. Or, in other words most of the laws are 'hard' constraints. Those of the present day, on the other hand. are becoming more and more open, and they leave many more options to the decision of the designer."

Another writer, Brian Lawson[37] refers to the function of constraints in the design process: "we have seen how design problems are becoming constraints which may be either internal to the system or object being designed, or may be linked with some external factor not under the designer's control. These constraints may be imposed most obviously by the

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[36] [Fukuda88, p.310]

[37] [Lawson80, p.76]

client or users but also by legislators and the designer himself" [Lawson80].

2.7.1 Regulations as a body of knowledge

Discussion about knowledge acquisition in terms of expert systems usually focuses on the role of the co-operative expert.[38] The writer has found no examples of work that has been done on distilling knowledge from bodies of regulations. Part of the purpose of this dissertation is to investigate such possibilities. Because regulations are carefully considered written statements it is a further interesting question to consider whether they represent a record of a particular society's attitude towards behaviour and which because of their open texture can be manipulated to have unexpected effects.

From what has been said we can see that the process of discussing regulations contains several difficulties; the overlap with the use of the word 'rule', their variety, imprecision of ordinary language, and a number of tenuous concepts some of which are far from settled. In addition there are external influences created by the legal framework, and society, which have a bearing on how regulations function. To help us be clear about the issues involved, the next chapter describes a model which tries to account for most of the points raised in this chapter to use as a basis for comparison of ideas. This also makes it possible to build up a more definite picture of the interaction between the various elements that make up regulations.

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[38] for example: statements made by Mital and Johnson in their description of the knowledge acquisition process. [Mital/Johnson92, p.86/7]

CHAPTER 3 LEGAL CONSIDERATIONS

Abstract.

This chapter considers the relationship between statutory regulations and the wider legal environment.

It explores legal complications that may affect the translation of legal statements into formulations that can be processed by computer. It considers legal factors, which have to be taken into account in making such a translation. It finds there are three principal complications about the role of rules and case law, which have a bearing on this dissertation: status of rules; the boundary between hard and easy cases; and the open texture of law. These matters are areas of debate in general law and they bear on several aspects of creating different versions of regulations.

The work of other researchers in the field of representation of legal statements by computers is described to provide a broad perspective of the issues that have to be addressed in investigating questions about the existence of internal structure within regulations.

The examination of possible legal objections to processing regulations by computer provides an overview of the role of legal statement as a prelude to demonstrating the possible existence of an underlying structure within regulations.

3.1 INTRODUCTION

The primary aim of using computer representation of regulations to look for the internal structure of regulations is to ensure that the analysis is consistent regarding the function of the various elements of which they are composed. A secondary objective is to facilitate comparisons between similar elements in different regulations.

This chapter considers possible complications, from a legal standpoint, to the idea of translating rules into a format that can be processed by computer, and how these complications may create barriers to such a process. There are questions about the accuracy and validity of different formats and their status in law. Is it feasible to trap accurately the essence of the law embodied in a regulation? Will the alternative representation have a legitimate status? Additional legal obstacles to creating alternative formats for regulations are issues stemming from considerations about the status of rules; differences between hard and easy cases; and the open texture of rules. These matters are reviewed to assess the restriction they place on how much we can rely on regulations re-constructed in the manner proposed.

These questions are discussed in the light of research into representing various aspects of the law using computer techniques. This chapter attempts to distinguish the special issues raised by earlier attempts at representing legal statements in this way, and which can illuminate a search for an internal structure in regulations. The implication of such research has raised an important issue in relation to the possibility of creating different versions of regulations and their status in law. If the process of representing the meaning of regulations by some form, other than the original words of the actual regulation, is to be of value the process will depend on arguments for the existence of an internal structure. The debate about the legal status of a regulation is likely to continue for some time to come. However, this is not a situation that has been created by computer methods, since

as we shall see there continues to be controversy about what the written regulation or rule should be taken to mean.

It should be pointed out that the term 'rules' is used in this chapter as synonymous with 'regulations'. This is because most of the literature about statutory legislation is focused on rules in general rather than on regulations in particular. Writers about the operation of the law are usually more interested in questions such as the extent to which judges, and those applying rules, apply discretion in the application of rules.

3.2 THE JURISPRUDENTIAL VIEWPOINT

The main part of the present chapter is devoted to the principle obstacles to building alternative representations of regulations in computer processible format. However, the wider legal issues having a bearing on this technique are reviewed first as an introduction to a more detailed consideration of these topics.

3.2.1 Jurisprudence

It is evident that many theorists, when accounting for the nature of law and legal reasoning, continue to disagree on fundamental issues about the ways in which the law operates. The main reasons given by Susskind are: basic philosophical issues, the disparity of which manifests itself in their theories of law; the aims of commentators in theorising about the law are often vastly different; theoretical accounts differ because of terminological divergences. To address this situation, he proposes a new role for jurisprudence in supporting the development of knowledge based systems as both a potential field of enquiry, and as a form of guidance for knowledge engineers.

The continuing discussion about the fundamental topics within jurisprudence reminds us of the fluid nature of subjects that provide the background to the operation of regulations.

Features of the debate which affect this research are set out briefly below before a review of work carried out by researchers in the field of computerised approaches to legislation.

3.2.2 What is the law?

Because this dissertation is concerned with regulations that are a subset of the wider class of rules, arguments concerning the position of written rules in law have a bearing on the subject matter. The subject is explored in detail by Susskind in which he discusses this question in the light of "legal science",[1] and he identifies the various entities to be represented in a legal knowledge base. He classifies these as: statute of law statements (referring to law held in legal codes); superior legislation; subordinate legislation and any written rules and regulations of fixed and determinate verbal form; and case law statements.

The last fall outside the context of this current study, but the work of Gardner and Schild in endeavouring to represent case law situations has a direct parallel in representing regulations. Susskind says "it is possible, in certain circumstances, to represent case law as general rules, or as I have called them, case law statements."[2]

Statute law statements and case law statements represent the formal knowledge of the legal domain and Susskind identifies two other entities related to these as *statute law predictions* and *case law predictions*, and statements derived from both. He discusses the difficulty of asserting the status of such derivations, but notes that "the derivative legal scientist's job of deriving rules,...is not dissimilar to the reasoning agent's activity in subsuming particular facts under more general rules".[3] The philosophical status of rules has been explored in detail in chapter 2 and it is clear from the various views referred to later that the position of

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1 [Susskind89, p75]

2 [ibid. p.90]

3 [ibid. p.102]

rules in general within the law is a subject of debate. This reinforces the suggestion that regulations may be a less 'contentious' area for investigation. This is a view supported by Schild when he says that "computer representation of quasi-legal rules may be an important area for investigation because decision making takes place according to specified rules and regulations and where an informal use is often made of previous examples and conclusions."[4]

3.2.3 The application of legal rules

Different theories about the function of the law recognise certain entities: a body of rules; cases tried by the judiciary; and the notion of different views about what constitutes the precise legal position in any case. This dissertation is concerned with statute law, of which regulations form a part, and which are entirely based upon written material. Nevertheless the determinations by the Department of the Environment in the case of Building Regulations are equivalent in some ways to case law. This is because they extend and clarify the meaning of a written regulation as a result of considering its effects in a particular instance.

A starting point for reviewing legal theories is to ask how binding regulations are in practice, in a formal legal dispute. Leith, a critic of computer representation of the law states that he follows Austin[5] in maintaining that the courts will always do what they like. He says that the law is in essences a social process:

> "... when we, so to speak, take a snapshot of this process we can discern 'rules,' 'principles' and any other aspects just as we can take snapshots of sons, daughters, nieces and nephews; but the snapshot of law is not 'the law' just as a snapshot of our relations is not 'them' "[6]

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4 [Schild92, p.18]

5 John Austin, an English lawyer responsible for the concept of 'legal positivism' (1790-1859)

6 [Leith86/2, p.4]

He deals at length with the function of the so-called 'ouster' clause[7] which he describes as having been instituted to limit the extent to which judges can modify rules to suit their own view of what should constitute the law in any given case. He illustrates how its provisions have been circumvented and opines that "the real problem of law is not the clarification of individual legal terms from the legislation, but the control of the judiciary." His conclusion is that "it seems as though the contents of a piece of legislation are not the main factor relating to the judicial discussion of it." In support of this view, Leith[8] then quotes Craig as stating: "Whether it would be possible to devise an ouster clause which succeeded in excluding review is less a matter of semantics than of judicial attitude and legislative response". "Expressed in another way," Leith continues, "even if deontic logicians could express legislation in a completely clear manner, this clarity would have little effect on the strategies and counter-strategies used by the courts and the legislature in their on-going negotiation over the rights and role of the judiciary."

As we have seen, Schauer takes the view that rules which are too flexible cease to be rules at all and that by passing complete discretion to those applying them, the rules themselves dissolve. Leith's position seems to suggest that this may, in fact, be the case. In trying to find an underlying structure capable of being represented clearly in computer processible format we have to take account of statements made to support these theories.

3.2.4 Regulations and the issues of rule status

Regulations have a special significance because they perform two important functions: identifying the area of application, and defining the response necessary to ensure compliance. There are difficulties in determining the status of any particular rule. As

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7 Leith describes the 'ouster' clause as" a clause inserted into legislation by the legislature with the clear intention of 'ousting the jurisdiction of the judiciary' ". [Leith86/2 p.16]

8 [ibid.]

Schauer reminds us: "Any conferral of jurisdiction is itself based on some background justification, some rationale for creating that jurisdiction and thus there will always be the possibility that a jurisdictional rule will turn out to be under- or over-inclusive with respect to a generating justification."[9] A key point is whether a rule stands in its own right or is part of a general set of 'principles' which influence decisions about specific cases. [10]

In reviewing the literature dealing with general legal topics and their relationship with regulations we find blurred boundaries between the subjects of regulations, rules and law in general. Schild contrasts the formal use by common-law of precedent and rulings in judicial decision-making processes with "quasi-legal" areas, in which category he places decision-making which takes place according to "specified regulations and provisions".[11] He concludes that: "One may therefore assume that computer systems for decision support in quasi-legal areas could be of even greater practical importance than in proper legal domains." He bases his argument on the view that in quasi-legal areas those applying the regulations may be less skilled at their interpretation than in formal legal situations. This is especially true in the case of building regulations because so many different kinds of people are involved, ranging from building product manufacturers to building control officers. He goes on to point out:

> "It is suggested that there are other potential advantages of representing rules and regulations in computer executable logical form independent of the actual use of computers. Representation in logical form helps to identify and eliminate unintended ambiguity and precision. It helps clarify and simplify the natural language statement of the rules themselves and therefore test them before they are put into force." [12]

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9 [Schauer91, p.170]

10 Schauer says: "If what appears to be a rule can thus be modified when its indications are inconsistent with a wise policy or the purpose behind the rule, then as we have seen the rule itself furnishes no constraint. If this is so, and this is how Bentham and others have understood the operation of the common-law 'rules' are indeed descriptive rather than prescriptive, functioning merely as temporary guides."[ibid. p.177]

11 [Schild92, p.18]

12 Schild expands on this by reference to an example due to Layman E. Allan which has become "part of the

3.2.5 Rules and the law

Dworkin[13] begins an overview of the relationship between rules and the law by creating a very abstract description, which is sufficiently general to be uncontroversial. He says:

> "Governments have goals: they aim to make the nations they govern prosperous or powerful or religious or eminent; they also aim to remain in power. They use the collective force they mobilise to these and other ends. Our discussions about law by and large assume, I suggest, that the most abstract and fundamental point about legal practice is to guide and constrain the power of government in the following way. Law insists that force not be used or withheld, no matter how useful that would be to ends in view, no matter how beneficial or noble these ends, except as licensed or acquired by individual rights and responsibilities flowing from past political decisions about when collective force is justified.
>
> The law of a community on this account is the scheme of rights and responsibilities that meet that complex standard: they license coercion because they flow from past decisions of the right sort. They are therefore 'legal' rights and responsibilities. This characterisation of the concept of law sets out, in suitably airy form, what is sometimes called the 'rule' of law."

Having set out a general view of the law and its relation with rules, Dworkin continues by identifying categories that closely correspond to the mechanistic, realist and positivist classes that are described below. They are conventionalism, legal pragmatism, and law as integrity:

- Mechanistic (conventionalism): this stance takes the position that all rules are valid.
- Pragmatists (sceptics): this takes the view that no rules are valid.
- Positivists: this introduces the distinction between cases that are easy to resolve and those that are hard. Easy cases fit comfortably within the rule framework and hard cases need to refer to superior principles for resolution.

The systems model in the next chapter shows that the situational specification contained in a rule or regulation is a specification of a particular situation. For the regulation to take

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folklore of the AI and Law community" dealing with the Library Regulations for borrowing books at Imperial College London. He uses this example to demonstrate that while easy cases may be resolved by using logical deduction this is not possible for hard cases. [ibid. p.67]

13 [Dworkin86, p.93]

effect it must be agreed that the situational specification is correctly described by the entrenched generalisation contained within the situational specification. If it is found that there is sufficient correspondence between the circumstances described in both cases then the response definition of the regulation applies. It can be seen that generalisations, with the additional flavour attached by entrenchment, create grey areas around each definition and these are open to challenge. Similar grey areas exist in the definition of the response definition. We can see therefore that the distinction between the various situations described above is that the position, taken by the positivists, provides for those cases where there is doubt about generalisations at one or more levels within a given situation.

3.2.6 The relationship between principles and regulations

Dworkin has argued that every case has a right answer and that it is the job of the judge to find this answer. In order to explain this position he argues that a proper legal base consists not only of the rules but what he describes as principles and policies.

> "The difference between legal principles and legal rules is a logical distinction. Both sets point to particular decisions about legal obligation in particular circumstances, but they differ in the character of the direction they give. Rules are applicable in an all or nothing fashion. If the facts a rule stipulates are given then either the rule is valid, in which case the answer it supplies must be accepted, or it is not, in which case it contributes nothing to the decision."[14]

He states that principles are what guide the judiciary when rules themselves are found to have gaps. This has significant importance for a context of any regulation and should be reflected within its internal structure.

3.2.7 Main issues affecting computer representations of regulations

The main issues we have to consider can be grouped under three headings: rule status; hard or easy cases; and open texture. However, behind each of these are the issues raised by

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[14] [Dworkin67, p.35]

Schauer regarding generalisations. His argument is that a rule that deals with a specific instance alone is not a rule at all, and that any generalisation of that instance must contain elements of over- and under-inclusiveness. Any generalisation is directly linked to questions of open texture, which brings us back to the debate about hard and easy cases. The role of rules as a decision making influence recurs, reflecting views expressed by Schauer and reinforcing the view that the content of a regulation should enable us to decide if it applies, and if so, to determine the appropriate response.

One view of regulations is that they provide a form of agenda for arguing the rights and wrongs of a relevant situation. As Gardner says[15]:

> "... there is a tradition, in law, that legal questions have correct answers. The tradition has long been out of favour academically; but it may still have a currency among laymen, it may still affect judicial practice and it recently has again raised academic controversy."

In fact there are two inputs to the legal reasoning process under Anglo-American law: the large body of case law, and statutes. The legal process is about the role of the judiciary, how it functions, how lawyers analyse cases for identifying key facts, and how they predict the outcome prior to advising clients whether to proceed. These themes are thoroughly explored by Gardner. Her investigation into representing case law, with special reference to identifying the existence of a contract between two parties, supports the use of computers for the analysis of individual cases. Her aim is a computer programme that recognises the relevant issues in a case, both for and against a particular legal decision. This is a process that is central to legal reasoning.

Bench-Capon and Sergot state that:

> "The requirement for conflicting rules, which argue both for and against the conclusion is essential. At the very least it reduces the influence of a rule which is actually wrong. More importantly, there are bound to be cases whose natural abstraction will contradict existing rules which are derived from other examples." and,

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15 [Gardner87, p.18]

> "Most researchers into the use of expert systems and other forms of knowledge representation for the law do not expect to develop systems that make judgement or predict a legal outcome. There appear to be two main reasons for research work: (1) to obtain an increased understanding of legal processes; (2) developing advisory systems which can draw attention to the key points of a particular case."[16]

This dissertation falls into the first of these categories and as a step towards the second.

3.3 THE LEGAL STATUS OF RULES

The first of the obstacles to translating regulations into computer processible format, determining the status of rules, is now discussed in detail. There are three main approaches to this subject which can influence how we regard the content of legal rules and affect the extent to which we should feel constrained when translating them into a different form of words. They are: mechanical jurisprudence; legal realism; legal positivism.

3.3.1 Mechanical jurisprudence

This as a term coined by Pound[17] in 1908 and has come to mean a view of law as axioms and legal reasoning as deduction. Dworkin has suggested that consistent practitioners of mechanical jurisprudence are hard to find.[18] The view of mechanical jurisprudence, if correct, would most closely support the possibility of representing rules in computer processible format, because it is based upon a view that all available material for the science of law is contained in printed books. This theory can be used to support the concept that it is possible to make a deterministic link between the written material and an alternative representation.

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16 [Bench-Capon/Sergot85, p.13]

17 [Pound08, p.605-623]

18 [Dworkin77, p.15]

The idea that it may be possible to represent the law as axioms and legal reasoning as a process of deduction has an obvious attraction for people developing expert systems. The term "mechanical jurisprudence", is a concept which has considerable appeal for those trying to ensure that judges carry out a predictable and accountable process of law enforcement. Mechanical jurisprudence is sometimes referred to as 'conceptualism' or 'formalism'. Gardner mentions the example of a practitioner of mechanical jurisprudence, Lendell, who became Dean of the Harvard Law School in 1870 and who revolutionised legal education by inventing the case method.[19] He argued from abstract concepts of contract to particular rules of contract law. The extent to which those applying rules have discretionary powers is the relevant aspect of the debate about mechanical jurisprudence. The force of the original justification, together with the amount of generalisation and the degree of entrenchment that has developed, has a bearing on decisions according to the rules. With increased sophistication possible in computer representation it may be time to reconsider whether some form of mechanistic legal process is possible, but at the moment arguments against it are still convincing.

3.3.2 Legal realism

Legal realism emerged as a reaction to mechanical approaches to the law. This view, sometimes described as nominalism, suggests that all that counts in law are the decisions in particular cases. Dworkin proposes that this can be seen as a semantic theory in which "the exact meaning of the proposition of law - the conditions under which lawyers will take a proposition to be true - depends on contexts".[20] He goes on to comment "Some realists express these ideas in dramatically sceptical language. They said there is no such thing as law, or that law is only a matter of what the judge had for breakfast." The main

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19 [Gardner87, p.19]

20 [Dworkin86, p.36]

feature of legal importance is its perception of legal rules, which in extreme cases are regarded as having no legitimate place in legal discourse. Dworkin gives the name "nominalism" to such a position:

> "in [the nominalists'] view the concepts of 'legal obligation' and 'the law' are myths, invented and sustained by lawyers for a dismal mix of conscious and subconscious motives... We would do better to flush away...the concepts altogether, and pursue our important social objectives without this excess baggage." [21]

This standpoint is also described as that of "the rule of sceptics" and, in support of that position, Leith says:

> "thus, even if rules were found and not created, they can only be law when they have been applied: and since they are 'found' by the judiciary, it may be that rules may not be new or judge-made but the law most certainly is"[22]

Gardner comments "if legal realism is right it appears to make the AI paradigm of expert systems inappropriate, at least with any simple mapping from legal rules to knowledge-based rules."[23] She puts forward some other approaches which could be adopted: to regard individual decisions, not general rules as having authoritative status as law; to emphasise the behaviouristic side of legal realism which is associated with an offshoot of legal realism called jurimetrics. She adopts a third possibility - to reinterpret the significance of legal rules saying:

> "Once articulated, they can provide guidance as to how future decisions can be kept in some rough conformance with this order; or if the articulated rule seems to be a bad rule, it can suggest a way of saying how the course of decisions ought to be changed."[24]

Schild characterises the position of American legal realists as representing the view "legal reasoning is not necessarily rule-governed".[25] He goes on to say "however, the general rule held today agrees that in difficult questions lawyers must look beyond law statements and

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21 [Dworkin77, p.15]

22 [Leith86/2, p.12]

23 [Gardner87, p.22]

24 [ibid. p.22]

25 [Schild92, p.50]

seek to predict court decisions. These difficult questions are what we have called 'hard' cases ". Dworkin uses the term legal 'pragmatism' to reflect a broader view of the law which takes into account the legal realist's viewpoint. He says "so pragmatists, strictly speaking, reject the idea of law and legal right deployed in my account of the concept of law although as we shall see they insist that reasons of strategy require judges sometimes to act 'as if' people have some legal rights".[26] He describes legal pragmatism as a "sceptical conception of law".

For this dissertation, questions raised by the rule sceptics go to the heart of whether it is possible to make sensible representations of the law in computer format. Despite the fact that the position of the legal realists has to some extent been answered by the positivists' standpoint, it does raise questions about the point of application of rules and the law in general when dealing with a particular case. This issue is of particular relevance for the general discussion on hard cases where clear guidance from written rules is no longer valid. Leith appears to support the realists' position: "simply put, my argument is that no amount of logical elegance of power ever ensured strict adherence to the letter of legislation, or the wishes of a legislature by the judiciary. For if we wish to ensure that the law is understandable and predictable we must look to different aspects of the law and that of clarity of legislation"[27]. He emphasises that law is not a "reified object". In adopting this dynamic view of law Leith seeks to explain why computer representation as exemplified by the work of Sergot is not relevant. His rather emotional way of expressing his arguments somewhat reduces their strength but they are valuable none the less because they are among the few arguments put forward against the current trend towards exploring computer representational techniques.

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26 [Dworkin86, p95]

27 [Leith 86/2., p4]

3.3.3 Legal positivism

In trying to balance the two views, an alternative theory - legal positivism - has evolved which regards the law of community as a set of special rules which are "exhaustive of the law". This approach implies that someone who has a legal obligation is to say that his situation falls under a legal rule that places an obligation upon him to do or to refrain from doing something. In connection with the positivism position Dworkin refers to the argument which "stresses the importance of distinguishing between standard or core uses of the word 'law' and the borderline or penumbra uses of the word.[28] He suggests that lawyers and judges all follow what is mainly the same rule for using law: "...but because rules for using words are not precise or exact they permit penumbral or borderline cases in which people speak somewhat differently from one another." He uses this as a reason to explain why lawyers disagree in hard cases as distinct from cases which fit comfortably within the agreed body of the law. Most working and academic lawyers who hold views on jurisprudence now accept this position, according to Dworkin, in one form or another.

Relating this idea of jurisprudential theory to the use of computers, Schild states that the school of American legal realism is similar to that of 'rule sceptics' and that if they were correct about this process of legal reasoning there would be no place at all "for academic computer systems".[29]

Gordon describes the central properties of legal positivism based on the views of Hart as:

> "(1) the law consists of a set of valid rules, which can be identified by applying a fundamental secondary rule of recognition
>
> (2) the valid rules are incomplete. Some cases, clear cases are definable by applying the rules; the others require the exercise of judicial discretion
>
> (3) legal obligations arise only out of legal valid rules.

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[28] [ibid. p.39]

[29] [Schild91, p.50]

> In a hard case, a party may be held liable for obligation which did not exist at the time of the events of the case."[30]

Legal positivism's recognition that the rules have gaps distinguishes it from mechanical jurisprudence. However, there is a trace of mechanical jurisprudence left in legal positivism's notion of clear cases: once the relevant valid rules have been identified and the case has been discovered to be clear, its decision follows deductively by a mechanical application of the rules to the facts.

This is an advantageous standpoint from the point of view of those trying to apply computer techniques to rule representation but leaves us with the problem of distinguishing between clear and hard cases. Leith however, continues to oppose even the suggestion of the possibility of any rule having a clear force.[31]

The impact of these arguments on the creation of rules, (by implication also regulations) is illustrated by the system model proposed in the next chapter. The original justification for creating laws or a regulation is based on the expectation of having an effect in the future (as Schauer would say, the influence of time over future acts). However, the generalisations, and indeed case law may come to affect interpretations of the rule which may no longer precisely meet the original circumstances.

Susskind uses the standpoint of legal positivism to defend purely deductive legal expert systems.[32] His main point is that despite the various sources of uncertainty in legal reasoning, because of the "core of certainty" of legal rules postulated by legal positivism in

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30 [Gordon91,p.96]

31 His example of the 'ouster' clause is illustrated by example designed to show that written law is only a law "when it is applied" and can be set aside very easily. Placing particular emphasis on the effect on the British Nationality Act he draws attention to illogical contradiction within the Act. On the one hand, the Act says that the decision of the Secretary of State shall not be subject to appeal and on the other, that nothing in this section affects the jurisdiction of any court to entertain proceedings of any description concerning the rights of any person under the provision of this Act. [Leith86/2, p.20]

32 [Susskind89]

all its versions, deductive expert systems can be useful tools for lawyers. He suggests that lawyers can be trusted to respect the limits of the system and know when other methods are required. On the other hand, Gardner directly addresses the problem of identifying the hard questions raised in school examination questions about offer and acceptance law. She attempts to develop a computational model of legal reasoning, which is designed to autonomously spot hard legal issues.

3.3.4 Principles as a guide to the intention of statutes

Dworkin refers to an example in the realm of courtesy to make us aware of the subtle distinction between different levels of rule status in a socially interactive situation.[33] His example makes very clear the spectrum of force of such unwritten rules of behaviour, which fall within an over-riding principle of behaviour. It also reminds us of the implications of the potential for change arising within the environment of rules.

Dworkin asserts that judges should construct a statute so as to make it conform as closely as possible to principles of justice assumed elsewhere in the law as a whole. He offers two reasons. The first, it is sensible to assume that legislators have a general and diffuse intention to respect traditional principles of justice unless they clearly indicate the contrary. Second, since a statute forms part of a large intellectual system, the law as a whole, it should be constructed so as to make that larger system coherent in principle. For our purposes the importance of this is that it implies a direct relationship between the written

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33 His example refers to the old custom that peasants take off their hats to nobility. "For a time this practice has the character of a taboo: the rules are just there and are neither questioned nor varied. But then, perhaps slowly, all this changes. Everyone develops a complex 'interpretative' attitude to the rules of courtesy, an attitude that has two components. The first is the assumption that the practice of courtesy does not simply exist but has value, that it serves in some interest or purpose or enforces some principle - in short, that it has some point - that can be stated independently of just describing the rules that make up the practice. The second is the further assumption that the requirements of courtesy - the behaviour it calls for or judgements it warrants - are not necessarily or exclusively what they have always been taken to be but are instead sensitive to its point, so that the strict rules must be understood or applied or extended or modified or limited by that point."

regulation and, using Dworkin's words again, "the more diffuse area of the law". The format proposed for representing examples of regulations from *The Building Regulations 1985* makes provision for this higher level of influence - the role of principle -by reference to the context of each regulation.

3.4 HARD AND EASY CASES

The distinction between *hard* and *easy* cases[34] is an issue that arises repeatedly both in legal commentaries. Earlier research described by the writers referred to into computer representation of the law suggests that a hard case can be characterised as one in which the outcome differs in some way from an interpretation of the rules or precedent which could reasonably be expected. This distinction forms an important part of writing about the use of computers to help interpret legislation and case law. It has been suggested by Gardner that one of the features which distinguishes the two types of case is whether they can usefully be represented in some sort of processible format. The general view appears to be that computer representation is suitable for identifying easy cases but may not have a role in relation to hard cases.

The importance for the possible existence of internal structure is that the phenomenon of hard cases means that there are factors affecting the outcome of cases which do not necessarily follow solely from the content of the rules which apply. Examples quoted by various writers suggest that determining which rules apply may also be a contributor to making a case 'hard'. This issue is discussed more fully in section 3.6 below, dealing with

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34 All the writers of books referred to in this chapter devote a substantial portion to the significance of the boundary between 'hard' and 'easy' cases.

35 All the writers of books referred to in this chapter devote a substantial portion to the significance of the boundary between 'hard' and 'easy' cases.

'open texture' because the questions it raises shed substantial light on attempts to model regulations in order to establish the presence of an internal structure. Showing the influence of generalisations and over- and under-inclusiveness does this.

We shall see, in chapter 7, that generalisations and entrenchments together with their associated side effects lie at the root of complications in the application of rules. The process of generalisation is closely related to the issue of both hard and easy cases, and the inevitability of open texture.

3.4.1 Significance for representation of regulations

The distinction between hard and easy cases is central to questions of interpretation because part of the distinction may stem from incompatibilities between the underlying internal structure and the surface representation of the actual rule or regulation. In easy cases the relevance of a regulation and the form of response may be clear, and not in hard cases. There also may be a question about the interaction of the actual wording and the legal context in which the regulation is situated.

All four commentators quoted on regulatory and legal representation tackle the issue of hard versus easy cases differently. Sergot makes passing reference to the issue by saying, "if a legal expert system could not anticipate decisions in the routine cases, we would be right to dismiss it".[36] Gardner takes a much longer look at the question because her system is specifically designed to expose the existence of hard case issues within a dispute about contract situations. Leith on the other hand suggests that "the very idea of a clear rule of law is an invalid idea".[37] Susskind bases his approach on an account of clear cases based on jurisprudential consensus. For him, the main point is that most cases usually fall within the relatively straightforward domain of clear cases. However he qualifies this by saying:

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36 [Sergot85/2, p.23]

37 [Leith86/1 p.6]

"When we speak about a clear case, it is, then, a case that is clear and not a rule".[38] Schild supports the view that using a rule-based approach to knowledge representation with logical deduction as an inference engine is acceptable for easy cases but not for hard ones. Looking at the representational techniques adopted by each we now examine the respective position of the writers quoted so far.

3.4.2 Sergot

In his paper "*Representing legislation as logic programmes*" Sergot describes three expert systems using Prolog to represent clauses of a target section of legislation.

A typical example of a clause from this legislation after conversion into Prolog is:

> "x is entitled to supplementary benefit and
> not x is disqualified by sex and
> not x is a juvenile and
> educational status of x is it OK and
> x is a GB resident and
> x is excused or registered for work and
> x needs financial help and
> not x is disqualified by trade dispute"[39]

This style of clause can be used to represent a regulation so that the key points of the legislation are revealed, and thus making it possible to test the truth status of each line. In the case of the first expert system described, the output is not simply 'guilty' or 'not guilty', but rather a set of arguments which then can be assembled about a specific case, some arguing for and others against. He emphasises that he is concerned with representing not the legal problem-solving process but the content of a piece of legislation.

His second expert system deals with entitlement to supplementary benefit. Sergot stresses "the rules express the author's opinion of what entitlement to supplementary benefit

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38 [Susskind91, p.238]

39 [Sergot85/2, p.5]

requires", and goes on to point out "the rules express his colleague's opinion..". This opinion is based on: extracts from enabling legislation and various supplementary regulations; a condensation of relevant case law; familiarity with the DHSS's interpretation of the law; and with its application on practice. Consequently, the rules are without legal authority. They express what is thought to be the requirements for entitlement to supplementary benefit and not necessarily what the law actually says. Although this make the new version open to challenge the essential details are likely to be sharply focused. This raises the question about the extent to which it is possible to eliminate the human expert from this process altogether, and add data to a system taken directly from the actual legislation.

Sergot's third example, dealing with the British Nationality Act, represents the regulation in a form which interacts with the user, who is asked a number of questions designed to establish the citizenship status of an individual. The output is a form of proof, which demonstrates how the system arrives at its conclusions. Both the second and third methods are axiomatic systems, which attempt to model some fragment of the law with answers computed by the programme. They are effectively theorems, being logical consequences of the rules in the formulation and information supplied by the user.

Sergot goes on to emphasise that: "a conclusion of the system is guaranteed to be accurate, if the axioms in the system are accurate".[40] This is a fundamental point. It explains why such emphasis must be placed on examination of proofs and the importance of documenting the source of the rules in the formalization. The approach to representation commonly described as 'frame-based' goes some way to meeting these objectives.

His approach is summarised in a joint paper with Bench-Capon[41], which suggests that a computer system which is designed to give advice on matters of law, and open texture,

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[40] [Sergot85/2, p.23]

should be less concerned with production of conclusions. It should deal with presenting arguments on which the user may base his conclusion. He pays little attention to hard cases and because his approach is to produce a series of arguments and counter-arguments it is for the user of the system to derive the conclusion that particular areas of a case will be difficult to resolve.

3.4.3 Leith

Leith in his paper "Fundamental errors in Legal Logic" questions whether it is possible to use logic programming as a representational tool for legal issues.[42] Because his main focus is on the role of the judiciary, whom he portrays as feeling unconstrained by statute law, there is no discussion of representational techniques. There may be a parallel between the role of the judiciary and building control officers in enforcing the Building Regulations. He discusses the ability of an expert system to predict judicial decisions based on the idea of a clear rule of law and finds that he cannot support such a notion. His conclusions remind us that there are risks involved in extracting logical assumptions from apparently straightforward alternative versions of a regulation. He examines allegedly clear rules using arguments, similar to those offered by commentators about legal practice, in an attempt to demolish the concept of mechanistic legal reasoning. Placing weight on decisions of individual judges, he shows how these are often the result of different interpretations of a legal rule. Referring to the Domestic Violence and Matrimonial Proceedings Act 1976 Section 1 (1) he describes the case of Cantliff v. Johnson where there was an apparent clear distinction regarding the removal of the male from the home. Successive judges reversed decisions of lower courts by introducing issues about transfer of property rights and the broader social perspective of matrimonial circumstances. He

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41 [Bench-Capon/Sergot85, p.17]

42 [Leith86/1]

concludes that there is little core of certainty and a large penumbra of doubt, even in what is at first sight a clear case, because of the difference in the conclusions reached.[43]

His critical analysis of the possibility of computerised representation of regulations illustrates some practical consequences of viewing regulations too narrowly. Explanations given by the Secretary of State in the various results of appeals and determinations dealing with building control tend to widen the scope of regulations when dealing with particular situations. Schauer's discussion of this in the context of "rule sensitive particularism" reminds us that different enforcement agencies may adopt different strategies. These strategies may have important effects on how rigidly rules are applied; on the one hand totally rule based, and on the other, particularistic decision making.[44] From a representational point of view it would then appear that a form of qualifier could show the extent to which an enforcement agency may apply rules strictly according to the wording. This could be handled by, for example, an updateable attribute changing from one enforcing agency to another. Accepting the views of Leith would suggest that this attribute would greatly dilute the effect of a rule or regulation with the effect of converting the regulatory environment to that of rule-sensitive particularisation.

3.4.4 Gardner

A form of representation adopted by Gardner as a basis for her work uses three distinct elements in establishing whether a contract exists.[45] The first of these is a series of statements in an outline frame holding the main features of a case in slots dealing with entities relevant to her chosen topic area. In addition she uses a transition network (a procedure which will be described in section 8.4.2) to describe the sequence of legal events.

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[43] [ibid, p.11]

[44] [Schauer91, p.97]

[45] [Gardner87]

Finally she provides a rule base using specialised data structures; rule set, rule antecedent and predicate expansion as in the following example which show the highly coded form used in representation and not easy to assimilate:

```
(sale Sale1)
        (event1 Sale1 Trans1)
        (transfer Trans11)
                (agent Trans11 Seller)
                (ben Trans11 Buyer)
                (time Trans11 T11)
                (obj Trans11 Salt1)
                        (salt Salt1)
                        (quantity Salt1 Vol1)
                                (carloads Vol1)
                                (number Vol1 1)
                        (quantity Salt1 Weight1)
                                (cwt Weight1)
                                (number Weight1 N1)
        (event2 Sale1 Trans12)
        (transfer Trans 12)
                (agent Trans12 Buyer)
                (ben Trans12 Seller)
                (time Trans12 T12)
                (obj Trans12 Money1)
                        (money Money1)
                        (quantity Money1 Dol1)
                                (dollars Dol1)
                                (number Dol1 (* 2.40 N1)
```

The system operates as a descending tree endeavouring to select significant issues by examining the sequence of events using the transition network. The outcome is a sequence of arguments where the range of responses at each node point is identified which confirm or deny the original assertion being examined. Where, for example, the programme finds that sending a particular document may or may not constitute an offer, the programme looks for further evidence to support different conclusions.

A special feature of Gardner's work is the use of examples for the types of things that are, and are not, covered by the predicates used in the rules. This is designed to fill gaps in knowledge already expressed by the frame structure. Her system produces a list of the issues in a case, identifying hard questions by creating a branch point in the tree framework with available new features entered at each lower level. Gardner suggests a way of

establishing criteria for determining the distinction between the two categories by using heuristics to resolve easy questions:

> "1. For variable standards it should be possible to recognise extreme cases where they occur. If the rule calls for something to be done within a time which is reasonable under the circumstances, and the problem states that the relevant action was done immediately a programme should be able to conclude that "immediately" was soon enough.
>
> 2. For legal predicates too far removed from everyday usage to have much intuitive meaning, there should be knowledge about the kinds of situations which these predicates have standardly been used to cover. Suppose A writes to B, "I hereby offer to sell you my car for $1,000." One does not need a full analysis of *manifestation, willingness,* and the like to conclude that this is a manifestation of willingness to enter into a bargain. If B replies, "I don't want to buy it" or "I'll pay you $850," it again should not take very complex reasoning to conclude that this is not a manifestation of assent to the terms of an offer.
>
> 3. For a predicate whose satisfaction or non satisfaction seems to be clear - either because, as in point 1, the predicate is a variable standard and the situation presents an extreme case; or because, as in point 2, the predicate has standardly been used to include or exclude situations of the kind presented; or simply because the predicate has a known ordinary usage from which the answer follows - there should be a way of defeating the apparently clear conclusion when the occasion requires it. Usually the program should take the obvious for granted: that someone walking around in a railway station is not sleeping; that someone sleeping in a park is not sleeping in a railway station. The problem is how it can do so and still recognise that cases like Fuller's - the sleeping messenger and the vagrant trying to sleep - raise hard questions - are left for further consideration."[46]

Gardner's method makes specific provision for exposing hard questions by a process of tests to establish whether answers can be constructed from existing data. It is interesting to note that in Gardner's example the list of alternative outcomes from the analysis is somewhat larger than a human lawyer would be likely to consider explicitly.[47] This presents another possible justification for attempting legal knowledge representation, which is similar to that for medical cases, in that the comprehensiveness of the search pattern is likely to be greater than that offered by even an experienced medical practitioner.

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[46] [Gardner87, p.42]

[47] [Gardner87, p.177]

3.4.5 Susskind

Susskind, by concentrating on what he believes to be the predominant area of legal activity - that of clear cases, has set aside consideration of more difficult issues.

> "However, I believe that the divergence of views within jurisprudence has been unrealistically accentuated by the typical foci of enquiry, in the legal theorists tendency to concentrate on the inherently contentious issues while ignoring 'straightforward' matters (which themselves may raise insurmountable difficulties for the less capable)...theorists do seem to agree on the forms of legal argument which are both possible and desirable in the clearest cases. "[48]

He later points out that there is no clear definition of these matters and suggests that what is lacking in the jurisprudential literature, is an articulation of the concept of clear cases (as expressly distinguished from hard cases, and a theory of the resolution of clear cases). He then goes on to attempt to define clear cases that are based on jurisprudential consensus.

> "It might be that Hart's original account of clear cases is more satisfactory: that a case is clear where a common linguistic usage of legal and ordinary terms renders the verbal formulation and acontextual meeting of a rule unequivocally applicable to some set effects. In that event, in any case where the terms of a rule are not so applicable, the case is not clear and the purpose of a rule may well be relevant." [49]

Finally Susskind summarises the situation in relation to cases in general by pointing out:

> "we can only be certain that a case is clear ipso facto: when we have judicial confirmation of our own conditional conclusions (assuming that the judicial decision itself is not defective in some way)."[50]

Susskind offers no specific representational technique apart from exploring the possibilities of deductive legal inference by referring to the argument from implied exception,[51] which

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[48] [Susskind89, p.27]

[49] [ibid. p.173 and 197]

[50] [ibid. p.239]

[51] Susskind demonstrates that to say that all A are X is not provable and that exceptions may exist (black swans) showing the inherent weakness of deductive legal reasoning.. On pages 20-4 he offers a jurisprudential specification and proposes 4 stages in the process: 1-fact gathering; 2- individuation of law-formulations into law statements; 3- subsumption of the facts of the case within the terms of the law-statement; 4-application of deontic logic in the selection of legal rules and their application to the facts as subsumed. He concludes that since only 2 is exclusively a human domain for the time being, deductive reasoning continues to have a key

raises logical representational problems.[52] Elsewhere, in a system designed to process latent damage law, the 'Crystal' shell was used to generate rules and technical statement preconditions, thereby assembling a knowledge base against which the facts of a particular case can be tested.[53]

3.4.6 Schild

Schild's book, *Expert Systems and Case Law,* makes frequent reference to authors quoted in this dissertation.[54] He summarises some of the general views held today and sees a close relationship between concepts of easy and hard cases, and shows they are related to issues created by open texture by using a frame-based approach with a number of text strings to fill each of the slots.[55]

He says:

> "we have a final remark concerning easy v. hard cases. The issue of distinguishing between them seems very fundamental in the rule-based paradigm. However, using a case-based paradigm may actually not be so important. One possibility is to build a system which, given the facts of a case, will retrieve the relevant cases (for and against a relevant decision), and leave it at that. The human user could then decide whether the case at hand is easy or hard and use the output of the system to draw his conclusions accordingly."[56]

Schild uses Prolog to create a knowledge base which operates interactively with the user who works through a series of questions until a 'yes/no' answer is obtained or until a leaf node has been reached. If answers of 'may be' are supplied for a leaf node no further

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role to play in constituting the methodical deep structure of the legal process. [ibid. p.20-4]

52 [ibid. p.193]

53 [Kepper/Susskind88]

54 [Schild92, p.187]

55 "Rule skeptics have been widely criticised for their views. However, the general view held today agrees that in difficult questions lawyers must look beyond law-statements and seek to predict court decisions. These 'difficult questions' are about what we have called 'hard' cases in the introduction." [ibid. p.51]

56 [ibid. p.56]

dissent is possible and the significance for the system is that a hard issue has been located and the user is advised. Obtaining 'yes' or 'no' answers at the primary nodes suggests that a case is easy and the system advises the probable outcome of the case. Schild shows how the differences between easy and hard cases become less important when a system is used to present arguments for both sides of either type of case.[57]

Schild also outlines a system 'Meta' for representing a quasi-legal domain. This learns by taking the outcome of requests from students to belong to particular study schemes, and recording the decision. Subsequent applications are measured against the knowledge base and logical connectives used to identify patterns that do not fit.

Schild also comments;

> "It is said that any lawyer can turn an easy case into a hard one, should he wish to do so. The legal reasoning simulated in META may be interpreted as an attempt to do this".[58]

3.5 OPEN TEXTURE

3.5.1 Open texture

Open texture is an aspect of both legal statements and language and as such there has been extensive consideration given to the subject by writers on both law and natural language processing. The perception of the former is represented by the description given by Twining and Miers who describe the open texture of rules under the headings of

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57 [ibid. p.133]

58 Schild suggests that conflicting rules should be included in a knowledge base to express their open texture by negating 'positive' conditions that may contribute, as in the case of his example,to a particular decision. [ibid. p181]

"continuous variation" and "implied exception".[59] Those trying to represent aspects of the law in computer formulations regard the open texture of legal statements as "an especially important source of hard questions".[60] The problem of open texture creates yet another restriction on attempts to analyse regulations because it is an obstacle to clear and reliable representation of legal statements. The legal implications of this concept are examined more fully in section 3.7 with comments on various methods to cater for the problem. The effects as a possible cause of disputes are considered in section 7.3.2 of Chapter 7.

The subject of open texture has been recognised as being one of the fundamental obstacles to deterministic law and Hart's doctrine is used by Susskind to introduce the topic[61]. It is a feature of natural language that it is essential for effective communication, and yet at the same time causes statements to break down under scrutiny. It has similarities to the concept of vagueness that may be deliberately inserted into regulations in order to provide for subsequent interpretation by the courts or those applying regulations. Because Schild refers extensively to the works of Leith, Gardner, and Susskind we can regard his summary as a balanced overview of this subject. The work of Schauer has explored how open texture naturally leads to generalisation, due to being applied in a limited domain, and

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59 [Twining/Miers92, p.224-7]

60 [Gardner87, p.3]

61 "If we are to communicate with each other at all, and if, as in the most elementary form of law, we are to express our intentions that a certain type of behaviour be regulated by rules, then the general words we use....must have some standard instance in which no doubts are felt about its application. There must be a core of settled meaning, but there will be, as well, a penumbra of debatable cases in which words are neither obviously applicable nor obviously ruled out:.. We may call the problems which arise outside the hard core of standard instances or settled meanings 'problems of the penumbra'; they are always with us whether in relation to such trivial things as the regulation of the use of the public park or in relation to the multidimensional generalities of a constitution. If a penumbra of uncertainty must surround all legal rules then their application to specific cases in the penumbral area cannot be a matter of logical deduction, and so deductive reasoning, which for generations has been cherished as the very perfection of human reasoning, cannot serve as a model for what judges, or indeed anyone, should do in bringing particular cases under general rules. In this area men cannot live by deduction alone." [quoted by Susskind87, p186]

eventually to entrenchment through over- or under-inclusiveness. At this point we are concerned with the effect of open texture on attempts to provide different representations of regulations in computer format. Schild comments on the issue of vagueness.[62]

> "we have previously observed that the law is intrinsically open textured. It has a precise definition only for those individual cases which have come to court and have been decided; there is no precise definition for what has still to be tried.
>
> The words 'vagueness' and 'imprecision' are sometimes used to express the idea of open texture. We shall *not* consider all those words as synonymous. In the case of the first two, one has in the general non-legal sense, no means of making a decision when required. However, in the case of "open texture" we have exact knowledge in past cases already decided by the courts ("pointwise definition"). As for future decisions we have no knowledge at all. Thus open texture is vagueness plus decision-scheme. However, the word "ambiguity" has a different meaning altogether, at least for statutory law.
>
> In the case of an ambiguity in statutory law what happens is one of two things: either the law is re-formulated in an unambiguous manner, or the interpretation by an appropriate court will form a precedent to be followed in all future cases."

Schild then goes on to compare different approaches to open texture: the method of approximation; and the uses of probability and fuzzy logic. Both of these attempt, by various means, to arrive at a numerical value to define the boundary between two alternative interpretations of a given situation. Being dissatisfied by either approach because of the deterministic problem, he then proposes rule-based and case-based paradigms. He refers to McCarty's theory of Prototypes plus Deformations as the only piece of research directly addressing open texture.[63] This is described as a series of components: the invariant; exemplars, each of which matches some but not all of the instances of the concept; and a series of transformations which express a relationship between the exemplars.[64]

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62 [Schild 92, p.28]

63 [McCarty82. p.354]

64 [ibid. p.102]

A starting point for discussions about the significance, in practical terms, of the problems of open texture, is to use facets of the open texture phenomenon to decide whether a case belongs to a core of certainty or to the penumbra. Using Sergot's representation of the British Nationality Act he points out that the formalisation of the act could be considered in three ways.

1. ignoring its open texture to yield a fixed single interpretation of the law
2. expressing the open texture but using a yes/no questioning approach removing the flexibility caused by the inevitable consequences of open texture
3. using for easy cases only, because they can be said to depend less on meanings that have potential to be disputed.

Schild points out that this result is similar to that obtained by a number of other researchers using statutory law programmes which treat all cases as easy.

For Schild, when a case belongs to the penumbra, it means that it can be argued in two ways. He discusses possible approaches as follows: "We have seen that existing systems either ignore the open texture of the law (Melderman), diagnose 'hard' cases (Gardner) or behave as if they assume initially that all cases are hard."[65] Schild points out the advantages of focusing on a particular legal domain because it is possible to work within a reduced range of different meanings for particular words and consequently a smaller number of meanings need to be represented.

3.6 Issues Affecting Processing Regulations by Computer

Having seen that the legal concepts about the role of rules in controlling the outcome of cases vary considerably, we now turn to the implications for reformulating regulations to

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65 [ibid. p.135]

be handled by computer. Many of the questions raised by Schauer have a bearing on what we should consider to be the content of the rule (or example of case law), which is being translated into computer processible format. These questions also affect how we should judge the results of tests described in Chapter 9.

In discussions about the function of rules in law it has been suggested here that the main topics relevant to this investigation are: rule status; hard and easy cases; and the open texture of the law. This dissertation makes use of the possibility that regulations can be converted into a form[66] which can be processed by computer in order to assemble evidence for the existence of an internal structure within regulations and identify specific details of the form of the structure. However, we have to ask how successful are the representations of regulations which can be created, and how reliable is the information obtained from the proposed method. Do the controversies over key points that will be outlined, invalidate the implications of the results?

Consideration of these questions provides an additional perspective regarding the practical application of some of Schauer's arguments regarding generalisation, entrenchment and over- or under-inclusiveness. Sorting out the main topics then provides us with some of the background for the outline specification for computer representation of regulations proposed in Chapter 8 below. Most of the authors quoted deal with the implications of converting written legal statements or case law into computer format. This dissertation adopts the position that because regulations arising out of written statute deal with narrowly defined domains, they are less influenced by broad questions about legal statements than case law. Nevertheless, the boundary between them is blurred in relation to representational issues because case law can, in some circumstances, be converted into rule statements.

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66 The writer's investigations suggested that the so called 'Frame-based format is the representational technique offering the best chance of obtaining useful results. These findings are described in Chapter 8.

In discussions about the function of rules in law, the main topics relevant to this investigation are ; rule status, hard and easy cases, and the open texture of law.

3.6.1 Can there be valid formulations of regulations for computer processing?

Much of the literature about computer representation of the law is about the possibility that legal propositions can be deduced automatically from legal sources of knowledge. Kelsen summarises the differences between sources of scientific and legal knowledge when he says that, "nature does not manifest itself in spoken and written words, as the law does".[67] Despite this apparent advantage there are numerous difficulties in processing the written manifestation of the law. Rule status, hard and easy cases, and open texture are the main impediments to creating acceptable forms of regulations for manipulation by computer methods. Breaking down regulations in the search for an internal structure clearly contains uncertainties whether manual or computer methods are used. When assessing the results of the analysis we need to be aware of the difficulties associated with attempting different formulations of regulations.

However, as Sergot points out, in addition to the advantages of speed and accuracy derived from working with computer representations of the law, such representations:

> "...can be regarded more usefully as a precise and executable specification of what the legislation tries to express. This suggests that executable formalisations can aid the drafting process itself, and that such techniques have applications outside the law for formulating and applying regulations in all kinds of organisations".[68]

He goes on to support the use of logic programming for researching legal questions because " it is the precision of logic which makes it an indispensable tool for analysing and reasoning with law." In support of his position he cites the work of a legal scholar, Layman Allan, who has advocated for many years the use of symbolic logic as a practical

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67 [Kelsen91, p.48]

68 [Sergot85/2, p.1]

tool for analysing and simplifying the content of legal documents.[69] Sergot's argument is summed up in his statement about the use of logic based computer languages: "the key contention is that legislation can be represented in a mechanisable form of logic, and that extended Horn clauses[70] are a natural form of logic to take for many kinds of simple legislation".[71] Furthermore, by reference to his work on the British Nationality Act, he illustrates why the use of a formal logic is not incompatible with the open texture of legal concepts.

Most of the writers referred to in the present chapter support by implication the use of some sort of computer representation of the law. The major exception is Philip Leith, who maintains that the law and rules in particular cannot be usefully depicted by computer techniques.[72] In so doing he appears to discount the point that much of the work in this field is to discover what complications arise when experimenting with computer formalisations. Because of the availability of computer tools for the manipulation of text, a number of relatively basic systems are now emerging[73] and this trend is explored in more detail at the end of this chapter.

3.6.2 Potential for knowledge-based representations of regulations

It seems evident that some progress is being made to understand obstacles to using computers for increasing our understanding of the legal process. We are a long way from using computers in the role of judges, but much closer to obtaining on-line advice regarding the factors that are important in a given situation.

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69 [Schild92, p16]

70 Horn clauses are the basis of the Prolog language.

71 [Sergot85/2, p.16]

72 [Leith86/1]

73 [Mital/Johnson92]

Establishing a consistent way of transferring legal statements into computer-recognisable form is fundamental to any attempt to use computers in this way. Apart from Leith, all of the authors quoted have expectations of success in doing this. Schild summarises the situation:

> "it is suggested that there are other potential advantages of representing rules and regulations in computer-executable logical form, independent of the actual use of computers. Representation in logical form helps to identify and eliminate unintended ambiguity and imprecision. It helps to clarify and simplify the natural language statements of the rules themselves and therefore test them before they are put into force".[74]

Mital and Johnson describe information systems available for practice support, showing how the application of theories originally tested out by researchers in knowledge based systems are beginning to be applied in everyday use for legal purposes.[75] The systems described are fairly simple at the present time but will provide useful feedback to extend our understanding of how difficult questions can be tackled. Many of the systems handle large bodies of text which support information retrieval processes necessary for legal practice. Most methods use conventional relational database techniques as a basis of cataloguing systems. The section of the book most relevant to this dissertation deals with statutory and regulatory reasoners and refers back to the work of Sergot on the British Nationality Act. That work suggests that formalisation of acts depends on whether they are well structured and whether concepts within the boundaries of the act are adequately defined.

There are significant different legal theories about the status of a rule or regulation to be considered when dealing with the special problem of transforming regulations in computer processible format. Furthermore we have to be aware that there will be a balance struck at the point of application between slight modification to suit the circumstances of the case

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[74] [Schild92, p67]

[75] [Mital/Johnson92]

and sticking rigidly to the text. Different writers see the distinction between hard and easy cases as having a range of implications for representing legal rules for processing by computer. The relevance of the internal structure of regulations to these issues is discussed in chapter 9.

CHAPTER 4 REGULATIONS FROM A SYSTEMS POINT OF VIEW

Abstract

This chapter considers what insights into regulation structure can be obtained from a systems view of regulations and what can be learnt about them from a systems model.

General concepts set out in the previous two chapters are used in relating the external environment of regulations to internal components with reference to The Building Regulations. In this way the model assists in presenting ideas about how legal and sociological systems interact with regulations. The potentially confrontational nature of process of the determining compliance is described. Mention is made of ways in which consensus is usually achieved in an environment in which both sides can generally be considered to be well-intentioned.

A model is proposed of the regulatory environment and of the components of regulations to provide a defined framework which enables a more precise discussion of issues arising out of the existence of regulations.

4.1 INTRODUCTION

4.1.1 Chapter outline

Chapter 2 presented regulations as prescriptive rules embodying sanctions. This concept was examined in the light of legal, sociological and philosophical considerations. Chapter 3 reviewed legal obstacles to representation of regulations in a form suitable for

manipulation by computer. The present chapter puts forward a systems model[1] to assist in distinguishing between the various parties, and pressures, involved in creating regulations and to point out the principal relationships connecting them. The model proposed is intended as a framework for portraying rather tenuous concepts, such as generalisations or over- and under-inclusiveness. For the purposes of this chapter it is important to draw attention to the difference between the use of regulation as a verb, implying the process of regulation, and the noun dealing with the instance of a prescriptive rule as defined in Chapter 2.

This chapter begins by looking at the principal system boundaries and by locating the features of regulations in that context. It goes on to show how the elements of a regulation are related to the various influences at work within the environment of an individual regulation. Regulations are also discussed in terms of the emergent properties, which are revealed by investigating their internal operation and considering how regulations relate their underlying justification to the imposition of regulatory constraints. As such the modelling technique is useful for portraying relationships between the regulation and its environment, and as a basis for discussion about internal structure.

4.1.2 The model used

The model proposed is based on the "soft systems" approach of Checkland[2] and deals specifically with *The Building Regulations 1985* and is expanded by reference to ideas contained in Schauer's work. It is also compared with the work of other writers dealing with general approaches to the structure of prescriptive rules. Establishing a framework for examining the idea that a regulation has an internal structure is central to the arguments of

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1 A simplified view of those features of the regulatory process to illustrate relationships between them to facilitate discussion about the possibility of an internal structure which has significance for this dissertation.

2 [OU84]

this chapter. The chapter also seeks to show that regulations exist as a system within other systems, and that the form of internal structure is influenced by the levels above, and with which the regulation interacts. The compliance process is found to be a separate influence, which may have a bearing both on the style of regulations and also on the way they fulfil their underlying purposes or justification. As a basis for organising arguments that follow in succeeding chapters, the model is further expanded to portray those components directly related to the creation of a regulation.

The model is assessed against the work of writers dealing with regulatory issues to compare their perception of regulations and attitudes to questions of the environment of a regulation. Once refined in this way, the model provides an overall framework for subsequently evaluating the idea of a deep structure model for regulations and fixes the location of the constraint mechanism. Chapter 9 of this dissertation, pays further attention to the importance of constraint mechanism, which (it is contended) is itself made up of further embedded levels, and functions as a sub-system within the complete regulation.

The chapter concludes by working through an example taken from the Building Regulations to show how the model applies in practice and to clarify the function of its constituent elements.

4.1.3 Legal concepts as part of the environment of regulations

We have seen from the previous two chapters that it is not easy to be clear about the precise nature of regulations. Aspects of the legal perspective which may affect the model are expanded upon before embarking on its description. Twining and Miers describe difficulties associated with the apparently simple task of confirming the existence of a rule of law.[3] They refer to a maxim 'cessante ratione, cessat ipsa lex' which they take to mean

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3 [Twining/Miers91, p211-214]

that when the reason for a rule no longer exists the rule itself ceases. Although they point out that for English law this interpretation of the maxim is not widely accepted, it implies a close connection between the justification for a regulation and wider aspects of the law.[4] This reflects Schauer's approach, emphasising the significance of examining the reasons behind a regulation, and the role of 'purpose' when trying to understand the origins of the regulation. Twining and Miers, remind us of about the difficulty of establishing why a rule was made:

> "The *cessante* maxim, literally interpreted, illustrates a simple model of rules as instruments of policies, purposes or other reasons. This model assumes that every law (and in the present context, every rule) has a single, precise, ascertainable reason which is co-extensive with its scope. None of these is a necessary attribute of reasons for rules; indeed, the interpreter for whom all five conditions are satisfied is fortunate. Thus indeterminacy of aim is only one aspect of why reasons for rules may give rise to conditions of doubt or may be of limited utility in resolving such doubts."[5]

The systems model is intended to help clarify some of the reasons why the question of purpose affects the internal structure of a regulation.

4.1.4 Modelling the regulatory process

The previous chapter indicated that the subject of regulations lies between a number of disciplines, each of which contains a large number of still unresolved issues in relation to the regulatory process. The subjects raised by the last chapter in discussion about law, sociology and philosophy are related to concepts put forward by Bennett and Chorley in their book[6] which looks at them from a 'hard' systems viewpoint.[7] The subject of how

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4 In passing it is worth mentioning that they use this maxim to discuss a simple model of a rule in relation to its original justification to illustrate how relationships with the "mischief" the rule is designed to prevent can vary. [ibid. p. 213]

5 [ibid. p.214]

6 [Bennett/Chorley78]

7 Hard systems are considered to be those dealing with well defined problems and where there are clear

issues of control and systems are bound together crops up in relation to regulatory processes throughout their book showing how pervasive the influence of the regulatory process can be. They also demonstrate the complex nature of issues surrounding the existence of regulations. The aim of the model set out in this chapter is to clarify questions such as: how a regulation comes into existence; how to assess performance of a regulation; and whether regulations represent a store of knowledge. The model shows the immediate environment of regulations with the general presumption that external factors affect internal structures.

4.2 SYSTEMS AND STRUCTURE

Figure 2.1 showing that regulations are a subset of prescriptive rules within the broader classification of rules is relevant to understanding the more detailed model, which is described below.

4.2.1 Key properties

Bennet and Chorley define a system as a set of logical operations acting upon and acted upon by one or more influences that lead to the production of outputs.[8] Beer identifies one of the key properties of systems as being "the generalisation of some behaviour invariably and invariantly exhibited by the system which is interpreted through the model as a law".[9] Another important aspect of systems - *emergent properties* have been described in the following manner:

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means/ends views.

8 [Bennett/Chorley78, p.1]

9 [Beer89, p.11]

> "The notion of emergent properties is central to system engineering. Emergent properties are those properties of a system as a whole which cannot be uniquely attributed to individual parts. Emergent properties arise from the interactions between the parts of the system." [10]

They have relevance to this dissertation because they denote properties possessed by the systems as a whole which are not explicable in terms of the entities studied in isolation, such as disputes and delays that take place during negotiations.

4.2.2 Effect of regulation on system behaviour

Gerald and Daniela Weinberg focus a large section of their book *General Principles of Systems Design* on the function of regulations in relation to the systems behaviour. They describe how regulatory processes interact with systems structure. They suggest that the effects of regulatory processes and the behaviour of systems can give evidence for the existence of structure: "Because a structureless system simply follows the input we can detect the presence of structure by noticing when a system does not follow its input".[11] This notion supports the proposition that regulations have an internal structure because the results of regulation do not always match the intended outcome.

Their work makes the operation of the regulatory process very distinct by examining different types of regulatory process showing how they affect the success of different models in representing behaviour of systems under consideration.

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10 [IEE93, p.3]

11 [Weinberg88, p 134]

4.3.1 Need for effective legislation

In the chapter of their book devoted to decision-making systems Bennett and Chorley deal with questions about regulations and the rest of the world with which they interact, making the point that observance of rules is a decision-making process, and thus directly paralleling the arguments of Schauer.[12] They point out that because of possible hazards arising out of the interaction between physico-ecological and socio-economic sectors of society there is pressure upon decision-makers in government administration to build effective legislation:

> "...however the possibilities of producing potentially disastrous side-effects from any control action, together with the demand on governments to satisfy an increasing proportion of human needs, desires and aspirations, have stimulated the creation of large scale decision-making systems through which administrators can operate in determining actions which are in some sense optimal and which commonly involve stochastic outcomes. These demands have arisen in environmental control (Meadows *et al*, 1971[13], Forrester, 1971[14], Clark *et al*, 1975[15]) through the realisation that catastrophic, irreversible effects from very small and seemingly unimportant decisions, and in socio-economic control through an increasing awareness that the unfettered 'free' economy can generate a number of violently inequable distributions, sectorally, socially and spatially (Harvey, 1973[16], McLoughlin, 1973[17])."

Bennett and Chorley's view of the relation between decision-making and regulation is summarised in their claim that "the aim of the decision-maker is to regulate unwanted

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12 [Bennett/Chorley78 p.250ff]

13 [Meadows71, p.205]

14 [Forrester71, p.142]

15 [Clark75, p.135]

16 [Harvey73, p.336]

17 [McCloughlin73, p.287]

disturbances in order to achieve a greater degree of personal or group satisfaction....". They cite Ashby's observation that "The aim of a regulator is to match the disturbances in the system environment and to operate counter-acting strategies: to match the variety of the input disturbances with the variety of the control system".[18]

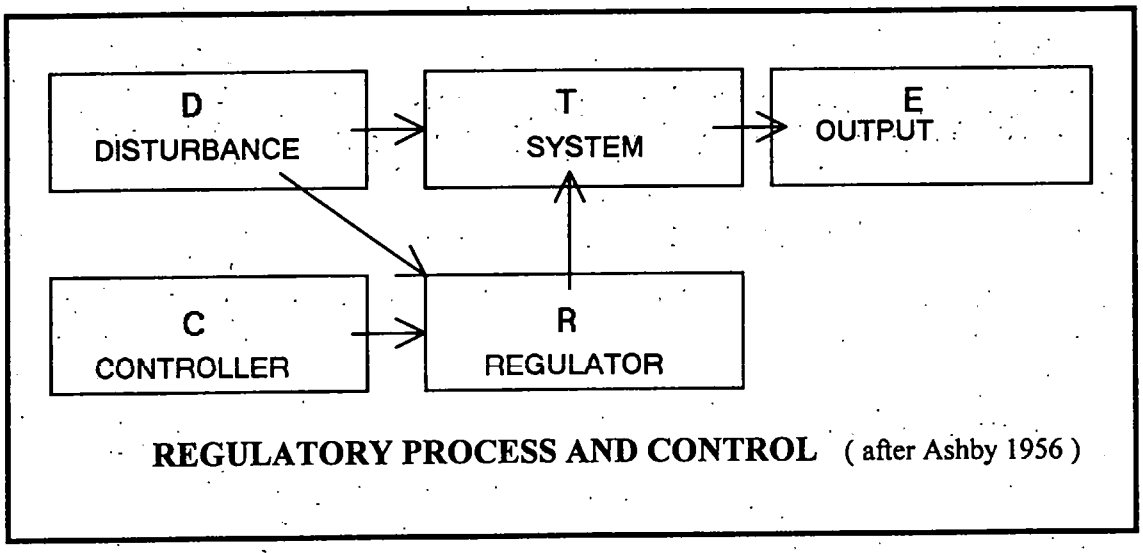

FIGURE 4.1

The model above[19] (regularly referred to in systems publications ever since) identifies the main parts of a control system and provides a simple representation of the interaction between the regulatory process and control, positioning the controller as decision-maker defining objectives for the regulation process. This model provides a comparison for the systems model presented in this chapter but does not show enough detail to locate the entities of the sub-systems responsible for much of the interplay between the main participants in regulatory transactions. Systems modelling assists in establishing boundaries between systems and subsystems making it possible to consider constructively the interaction between the individual entities which have been identified. The existence

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18 [Ashby71]

19 [Ashby56]

of these exchanges has been made more obvious by the stages of soft systems analysis.

4.3.2 Channel capacity for the purpose of regulation

Beer suggests that information theory and the work of Shannon and Weaver influenced Ashby's model.[20] Ashby's concept of the 'Law of Requisite Variety'[21] deals with the relationship of channel capacity to the aim of regulation to achieve adequate control. If such a relationship exists then it is implicitly quantifiable by some means or other because it should be measurable.

This is an aspect of less importance to this dissertation but which nevertheless implies the possibility of a more quantitative approach to the study of regulations than has so far been the case. However the ideas it deals with are of more relevance to the approach of "hard" systems where quantitative measures are more usual. Its main contribution to this dissertation is the way it suggests that the function of regulation can be regarded as a process, when considering issues of control, in constraining a system by influencing its output. It has a relationship with the concept of the constraint mechanism described in Chapter 9 because of its frequently quantitative nature.

4.4 "SOFT" SYSTEMS MODEL

4.4.1 Revealing the lack of an 'end state'

The 'soft systems' approach evolved to deal with difficulties which are defined in the terms of the perceptions and interactions of the persons involved. The 'soft systems' approach

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20 [Beer89, p.17]

21 [ibid. p.115] "R's capacity as a regulator cannot exceed R's capacity as a channel of communication"

was adopted as an alternative to assembling a representation of the regulatory process based on the sequence of steps described below for obtaining approval under *The Building Regulations 1985*. The result is an expanded picture of relationships between the main parties and situations concerned with this process. Some observations on comparisons with other sets of building regulations and different type of regulations are made in the next chapter. Reference to Shauer's work enables us to add further details to the key elements whilst picking up arguments explored in previous chapters (figure 4). An important difference between the results of this method and the Ashby model is that they do not make explicit the notion of an end state to which the model is converging. Since this is such a fundamental distinction the expanded model assumes that is implied in Schauer's discussion about "The Argument from Stability" in the chapter dealing with the reasons for rules. He says:

> "Other decision-making environments, however, focus on yesterday and tomorrow as much as today, emphasising the recurrent rather than the unique elements of the human condition. Here rules have the greatest role to play, generating a format for decision-making which channels decisions toward consideration of a comparatively limited number of factors likely to be repeated over time. In such an environment, missing the right answer now and then is thought to be less than catastrophic. The occasional sub-optimal result is seen as an error worth tolerating, a price to be paid for the advantage which comes from crowding the variety and fluidity of experience into the constraining and therefore stabilising pattern of decision according to broadly applicable rules".[22]

4.4.2 Applying for approval under The Building Regulations 1985

The building regulations are described in detail in the next chapter. The various entities involved in procedures for obtaining building regulations described briefly to clarify the description of the systems model that follows. Knowledge of the procedure has been accumulated by the writer from long experience in submitting applications for approval

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22 [Schauer91, p156]

under this and previous versions of the building regulations. This knowledge makes it possible to identify the relevant entities within the process.

4.4.2.1 the actors

The various parties, referred to as 'actors' are: members of the public; design team; building control department and its officers; building contractor; owner of the property; the Department of the Environment; and the Secretary of State for the Environment.

- Members of the public are involved as owners, and users of buildings. The main aim of the building regulations is to ensure their health and safety in the latter category. Most are quite unaware of the existence of the building regulations until involved in building works. Obtaining approval is left to the building designers and members of public remain largely unaware of the content of the regulations.

- The building works designer varies from a single person employed by a builder or building owner to a large inter-disciplinary team composed of architects, engineers, and specialist suppliers of materials and equipment. Their level of knowledge is expected to be nearly as comprehensive as that of building control officers. However, because of their need to cover a much wider range of subjects, from user requirements to cost control they do not have such in depth knowledge.

- The building control department and its officers are employed by the District Authority responsible for the area in which the works are to be carried out. Officers concerned with the application of *The Building Regulations 1985* receive retraining when new versions of the regulations are promulgated. In addition they are informed of new interpretations of difficult areas of the regulations and spend most of their working time focusing on interpretative issues. It is reasonable to expect them to have the highest level of knowledge regarding compliance with the building regulations.

- The building contractor role also may vary from the single jobbing builder to an

international organisation employing sub-contractors and numerous specialist firms such as piling contractors. Contractors are in a similar position to members of the design team but are usually more concerned with the practical issues. They come into contact with building control officers in their role as inspectors of the works in progress. If non-compliance is discovered and continues contractors can receive an enforcement notice requiring immediate rectification.

- The owner of the property where building work is to be carried out may be a private individual, corporate body or local authority. In relation to the building regulations they are in a similar position to members of public. They are not involved in discussions regarding compliance unless a dispute arises when they may become concerned about possible delays and additional expense
- The Department of the Environment is the body responsible for publishing *The Building Regulations 1985*. A department within the DOE drafts regulations for discussion with informed bodies within the industry and produces the final version for publication as part of a Statutory Instrument.
- Secretary of State for the Environment is responsible to Parliament for determining the content of the regulations after consultation with the DOE and relevant organisations such as the Institute of Building Control, the Royal Institute of British Architects, and Chartered Institute of Building. The Secretary of State responds to Appeals and requests for Determinations when a dispute cannot be resolved by negotiation.

4.4.2.2 the procedure

The impact of the regulations begins when the building designer converts the original sketches into technical drawings from which the building works will be carried out. All aspects of construction are reviewed against the relevant section of the building regulations. For example, ensuring that ramps do not exceed limits stipulated for length and steepness. The completed drawings are then sent to the Building Control Department for approval under *The Building Regulations 1985*. In most cases the building control officer will find a

number of issues that may not comply and further information is requested from the building designer. Most of the points are resolved at this stage but there may be a residue of matters that are not straightforward. Negotiation then takes place to try to come to an agreement over the changes needed to remove obstacles to granting approval. Occasionally one or two sticking points remain and an appeal or request for determination to the Secretary of State is needed to obtain a resolution.

Inspection of the building works in progress may also lead to disagreement about the form of construction being adopted. This aspect of disputes is dealt with more fully in chapter 6 below.

4.4.2.3 relationships

The relationships are illustrated graphically by the systems model below. The various pressures that operate on a regulation are described in section 4.6 dealing with the expanded systems model.

4.4.3 Methodology

The approach used was based on the methodology developed by Checkland.[23] The main characteristics of the regulatory situation as it applies to building regulations were listed in detail. The next step was to produce a 'Rich Picture' of the main features showing the 'actors', processes and relationships which are involved within the domain under consideration.

In this case these are:

- hierarchical relationship between the creators and administrators of the regulations
- exchange of documents as a way of operating the system
- lack of feedback built into the system

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[23] [OU84]

- potential for conflict between 'actors'
- control by defined constraints
- compliance process mainly achieved by consensus

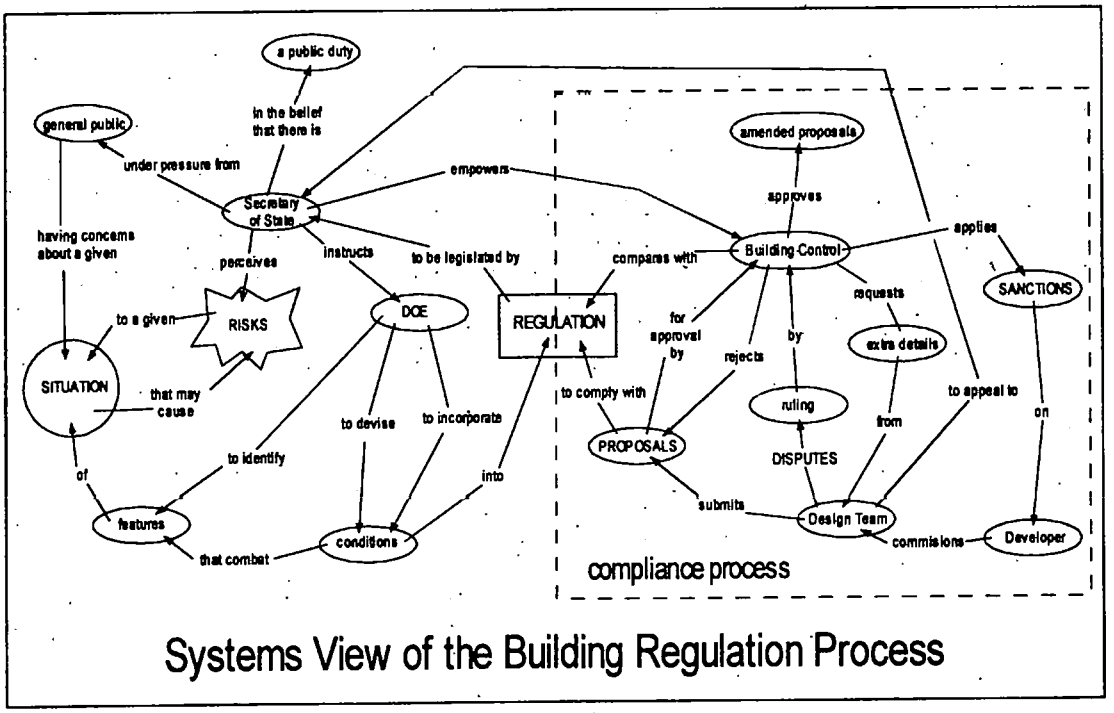
4.4.4 Root definition of a relevant system

A root definition of a relevant system derived from this analysis describes *The Building Regulations 1985* as a system to:

> Protect people in and around buildings and conserve energy usage by obtaining certain minimum standards of construction in most constructional work through someone giving approval to proposals (or finished buildings) which comply with the standards in the belief that there is a public responsibility to reduce risks to building users, those affected indirectly by their existence, and to conserve energy in an environment of responsible, compliant trade and professional people.

4.4.5 The regulation and its environment

After a series of exploratory attempts, the activities involved in supporting such a system led to the following model:



Systems View of the Building Regulation Process

FIGURE 4.2

The structure of a regulation arises out of factors shown in the left hand side of the diagram and in addition, the regulation takes into account the requirements of the compliance process in order to achieve the aims of those responsible for its creation. The regulation lies at the junction between the forces responsible for its creation and the mechanism for ensuring compliance.

The diagram is 'read' by following the arrows from their object of origin through to the terminal arrow as follows:

'The Secretary of State instructs the DOE (Department of the Environment) to incorporate conditions into Regulation'. The diagram shows how the influence of the general public feeds through to the definition of the situation thought to require control. It also illustrates the importance of correctly defining the 'features' of the 'Situation' and 'Risks' so that appropriate limiting 'conditions' can be determined.

4.4.6 Emergent properties

In the case of the Building Regulations the desirable emergent properties are safer and more fuel-efficient buildings. On the negative side they are the disputes and delays which arise from differences of opinion about the application of regulation.[24] Chapters 6 and 7 look at the characteristics of these undesirable emergent properties and the information they yield about the details of internal structure within regulations.

4.4.7 Compliance

The disputes and bureaucracy generated by the system are found in the compliance process. Nevertheless it will be shown that most of the causes are hard to eradicate, being partly the inevitable consequence of regulatory control as a process and also due to gaps in

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24 Systems engineers seek to maximise the beneficial emergent properties and "Adjust the system models to minimise the effect of undesirable emergent properties. [IEE93, p7]

the underlying structure of the regulation. The role of approval in the system differentiates the Building Regulations from the form of regulation being adopted more extensively at the time of writing. In the newer form of regulation (such as those emanating from the Health and Safety Executive) compliance is assumed until something goes wrong. It is then for those who have the obligation to comply to demonstrate that all appropriate requirements were correctly observed.

4.4.8 Avoiding conflict by arriving at a consensus

In the regulatory process described above it is clear that their attitudes to obtaining compliance will vary according to the particular interests of each of the 'actors' and their levels of knowledge. The advantages of specialised knowledge about the operation creates a hierarchy of authority regarding decisions that can only be challenged at the risk of delay and possible expense if issues go to Appeal.

The stages of negotiation usually involve trade-offs where doubt arises about the exact implication of disputed clauses.

The primary aims of *The Building Regulations 1985* concern maintaining the health and safety of persons in and around buildings. All parties are keen to uphold these objectives but come to differ about the reasonableness of how the general goal is converted into individual cases. It is this situation that the comments of Schauer have direct relevance by providing insights into rule-based decision making and particularisation.

It can be reasonably presumed that all parties benefit from speedy resolution of items of disagreement. However, when a new aspect of a regulation emerges it is usually the building control department that tries to impose what it perceives as higher and beneficial standards in the application of the regulation's requirements.

One reason for encouraging compromise may be heavy workloads on one side or other. Alternatively, concessions on points with little cost effect may get permission to adopt a

form of construction which is deemed to satisfy the essential purpose of the regulation without exactly conforming to limitations laid down by the regulation in question.

It is interesting to note that the department of the DOE concerned with setting the regulations had no record of a dispute proceeding to a Court action despite the relatively large number of matters referred to the Secretary of State for Appeal or Determination.

4.5 DETAILED MODEL

4.5.1 Reducing the scope of the model

The links between the left and right sides of the model deal with empowerment and appeals. For the purposes of this dissertation, empowerment is disregarded as unlikely to have an influence on the internal structure of a regulation. This lack of direct influence is emphasised by the fact that the regulations could operate without change to their technical content, if compliance were taken for granted unless a complaint arose or a problem arose exposing failure to comply. The appeals process probably only affects the structure of regulations by revealing their omissions and constructional shortcomings. However, chapters 6 and 7 discuss how the process of appeal helps us to understand more about individual regulations as a result of the careful scrutiny they receive during a dispute.

It has seemed reasonable therefore to produce a more detailed version of the regulation model by concentrating on the salient features most closely reflected in a typical regulation. The first step has been to reduce the number of factors to be accounted for by concentrating on the lower half of the left-hand portion of Figure 4.2.

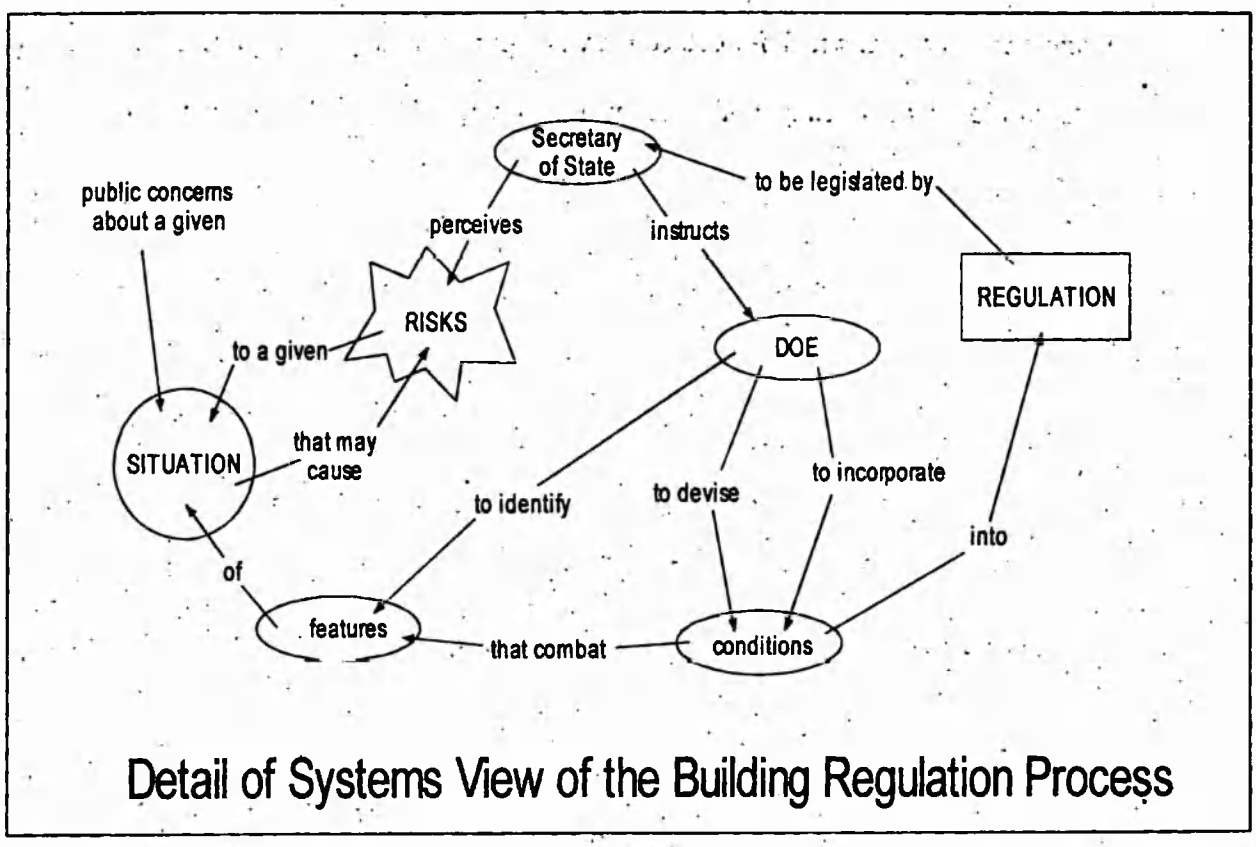

FIGURE 4.3

The key participants in the system dealing with the need for these regulations are seen as the decision making body - the Secretary of State - and the executive body - the DOE. The components of the regulation which are synthesised to generate the regulation are:

- the situation and its features
- risks related to that situation
- conditions designed to counter the perceived risks

4.5.2 Features of the situation

Taken together, the features provide a description, in as much detail as considered necessary, of the particular situation requiring regulation. They translate into the specification of the situation referred to in the remainder of this dissertation as the

situational specification. They determine when each regulation is applicable and thus form a description of the circumstances that cause the regulation to take effect. Susskind's work extensively analyses the kinds of topics to be included under this heading, not all of which are relevant to this study because of the broader scope of his interest.[25]

4.5.3 Risks related to that situation

The risks arising out of the existence of the situation under scrutiny form the underlying justification for the creation of the regulation and are intended to be offset by constraints imposed through the conditions. More attention is now being paid by the DOE to more structured methods of risk assessment when designing regulations in an effort to be able to monitor the effectiveness of new legislation.

4.5.4 Conditions to counter risks

This element of the regulation is where the limits on constructional techniques are imposed. It is the core of the second part of the regulation, the 'response definition' and made up of two principal components: features to describe objects derived from the situation to be controlled; and the constraint boundaries. The 'response definition' of the regulation set up limits designed to prevent the current or anticipated disturbance and includes a group of generalisations and entrenchments which reflect similar processes operating within the situational specification. This group of generalisations includes the constraint, which defines limits set for the boundaries of acceptable behaviour. The objective of the system is to counter the *features* of the *situation* which are considered a possible cause of *risks*. When the desired objective is not completely achieved there may be a number of 'recalcitrant experiences', which range from disputes to the existence of a wide variety of standards. The causes of problems with regulations are indicated as

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25 [Susskind89]

directly associated with the regulation. They may also arise during the drafting of a regulation because of: language problems; the legal environment; the drafting process itself; or the relationship of the regulation with the overall environment in which it is located.

4.6 EXPANDED MODEL

Shauer's description of the contingent attributes of regulations provides a checklist of items which can be added to give a more detailed view of the relationship between basic parts of a regulation. This further step makes it possible to find a specific location for the main arguments explored in previous chapters and serves as the background to the remarks that follow.

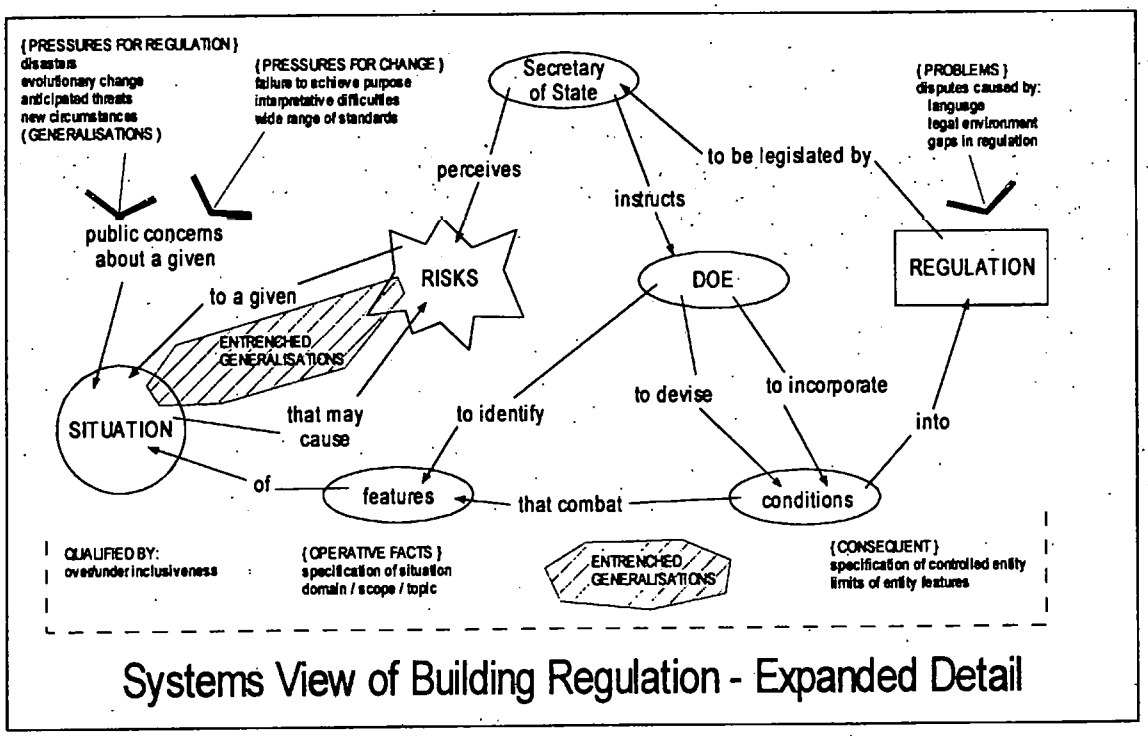

FIGURE 4.4

4.6.1 Forces influencing creation and change of regulations

4.6.1.1 creating regulations

The reason why a regulation is created in the first place is usually public concern leading to parliamentary lobbying or government pressure to carry out some legislatory change to alleviate a problem which is believed to be a concern of the electorate. There may be a variety of reasons lying behind the decision to make a new regulation and these coalesce into the generalised justification given in the Statutory Instrument published to give effect to passing the new regulation. Examples will be given in the next chapter.

The role of justification is a key factor for Schauer in his arguments about the difference between the original reasons for a rule and its eventual instantiation. This difference is especially important in relation to his discussion about entrenchment. It is worth noting at this point the subtle difference between justification and purpose, since the original purpose may require framing as a justification in order to attract support. The meaning of the purpose of a law or regulation is normally used by legal commentators in connection with issues of interpretation rather than the more technical meaning used in this dissertation applied to the word 'justification' as the underlying reason for the regulation. Societal and political viewpoints can shift suddenly, particularly in terms of perception of risk, with the result that the original basis of concerns can come to be quite differently perceived over time.

Conditions that lead to creating new regulations are:

- disasters (Ronan Point)
- evolutionary pressures of change (widespread use of refrigerators instead of larders)
- threats which are anticipated as arising in the future and for which legislation will be required to prevent disaster (unventilated hot water systems)
- new circumstances (development of new building types such as shopping malls linked to leisure centres)

The regulations requiring insertion of fire breaks in cavities were imposed following a disastrous fire in an old person's home in which several people perished. The new Construction Design and Management Regulations are a response to widespread concern about the large number of deaths and injuries on building sites. Evolutionary pressures can be seen behind legislation governing means of access for disabled people to buildings with greater acceptance of the use of wheel-chairs. The current debate about genetic engineering[26] illustrates pressure for setting up controls before undesirable repercussions arise with potential hazards caused by entirely new techniques being experimented with for control of pests and disease. New forms of construction, such as the introduction of pressurised hot water systems have led to introducing new requirements[27].

These influences can be seen as threats to a set of conditions regarded as acceptable or as required to change conditions to improve current unsatisfactory circumstances. These are initially described in generalisations about the form of the state or situation. The descriptions come to represent a specification, which the drafters of legislation regard as encompassing the most important factors leading to the risks, or perceived risks and are the 'situational specification' which trigger the 'response definition'. Most importantly, these generalisations become entrenched during the application of the regulation, as Schauer has indicated. He goes on to emphasise that the decisional force of the regulation is located in this entrenchment.[28]

4.6.1.2 pressures for change

There are three sets of circumstances to recognise: failure to protect the ideal state where

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26 [Levidow94]

27 [Building Regulations85, Section G3]

28 [Schauer91, p.135/6]

the regulation is not performing as originally intended; a wide range of standards arising out of differences in interpretation by enforcing agencies; and excessive difficulties or disputes involved in interpretation. Most of these arise when entirely new sets of regulations are implemented, with the result that initial publication is frequently followed by amendments, which try to sort out anomalies that have emerged when the new regulations are first applied. In general, building regulations in one form or another have been in use for such a long time that most proposals for revision are caused by events that fit the descriptions given under the heading 3.5.1 above. However, detailed changes are usually incorporated when new editions of building regulations are published, as for example the omission of the requirement for a minimum ceiling height in habitable rooms in the 1992 version since this restriction is no longer deemed necessary.

When problems are repeatedly experienced with one or more regulations there will eventually be pressure for revisions to be made. It will be shown in chapter 6 that four primary groups of conditions have to be taken into account when reviewing difficulties with regulations: language; the legal environment, effects of drafting or incomplete templates; and alterations within the overall regulation system environment. A major focus of this dissertation is the information which can be discovered by looking at the deliberations surrounding an appeal (or request for determination) where the enforcing authority and the applicant cannot agree about the exact meaning of the regulation.

4.6.2 Entrenched generalisations

Chapter 2 described Schauer's view of the importance of generalisations attached to prescriptive rules. This section deals with the process of entrenchment that he presents as both a simplification and a specification. He devotes three chapters out of nine in his book to considering the significance of the phenomenon of entrenchment arguing that: "entrenchment is what enables a rule to resist the impulse to modify in the face of

recalcitrant experiences".[29] In representing the internal structure of a particular regulation it is therefore necessary to provide for identifying the extent to which the various internal definitions have had their original meanings modified in this way.

4.6.3 Over- and under-inclusiveness

Schauer gives an example of the effect of an over-inclusive generalisation where 'no dogs allowed' prohibits those dogs which would not create a nuisance and of under-inclusiveness as realising which agents other than dogs can create disturbances. Thus the specification of the situation can be both under and over inclusive from different points of view. Writing about factual predicates (termed situational specification in this dissertation) he goes on to say:

> "Rules thus hinge on factual predicates which are (usually) probabilistic and under-inclusive generalisations with respect to the justifications for the rule. Because generalisations are necessarily selective, probabilistic generalisations will include some properties which will in particular cases be irrelevant, and all generalisations, whether probabilistic or not, will exclude some properties which will in particular cases be relevant. Factual predicates will therefore in came cases turn on features of the case which do not serve the rule's justification, and in others fail to recognise features of the case whose recognition *would* serve the rule's justification."[30]

Over- and under-inclusiveness are therefore inevitable consequences of the specification process and part of the way in which entrenchment occurs.

4.7 THE MODEL APPLIED

An outline example is now given to show how the model can be applied to identify the main components in the regulatory structure. This is designed to show the principles

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29 [Schauer91, p.62]

30 [Schauer91, p.33]

involved and the methodology will be elaborated on further when computer representation techniques are applied in later chapters.

The Building Regulations 1976 included a clause K6 (1) :

> "Any larder for the storage of perishable food (other than an enclosed space having a means of refrigeration) shall (unless it is adequately ventilated by mechanical means) be ventilated to the external air by means of:
>
> (a) one or more windows; or
>
> (b) two or more ventilators capable of being closed, of which one is in the upper part and another in the lower part of the larder."

By applying the breakdown based on the model we can obtain the following elements:

Pressure for the regulation, the justification - (implied):

> appears to arise from evolutionary pressures for improved standards, and aimed at preventing a lack of properly ventilated space for storing perishable food - the underlying generalisation is in the classification of perishable food and under-inclusive by not referring to dry goods.

Risks - (implied):

> perishable food may become hazardous to health if kept in unventilated spaces - here the generalisation is that food decay is delayed by ventilation and as such is under-inclusive by not dealing with other forms of deterioration.

Situation - (the situational specification):

> if a larder is being constructed for the storage of perishable food (other than an enclosed space having a means of refrigeration) - larder being an under-inclusive generalisation for a separate enclosed space having a separate doorway.

Conditions - (the response definition):

> it shall.

Constraint mechanism:

> be ventilated to the external air (unless adequately ventilated by mechanical means) by the provision of either:

a window (with no further stipulations) or

ventilators in the upper and lower parts of the larder having the sole limitation that they are closeable. (the generalisations relate to the terms 'ventilate' or 'ventilation' and window, ventilators, upper and lower parts of the larder).

In the next chapter this regulation is compared with the provision of the Building Regulations 1985 which include a newer version of this clause, G1, requiring the provision of accommodation for storage of food or space for the provision of same by the occupier. From the point of view of changes to regulations it is interesting to note that by the Building Regulations 1990 this regulation clause has been deleted.

4.8 COMPARISON WITH OTHER RULE MODELS

The views of other researchers regarding the structure of rules are reviewed briefly to enable an comparison to be made with the proposed model.

4.8.1 Susskind's approach to structure

Susskind has taken the process of rule modelling into the area of artificial intelligence by his work on the law relating to limitations of liability and expert systems in law. He introduces the notion of "individuation" and "structure".[31] The first is a form of taxonomy for classification within law which sits at a higher level than discussion about regulations. He examines different views of structure by comparing arguments presented by different theorists on the formulation of rules, commenting that there is indeed" a remarkable degree of consensus" among theorists mentioned about the division of a rule into antecedent and consequent. The systems model proposed above reflects that division by including the

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31 [Susskind89, p.118]

situational specification arising out of the 'situation' and the *response definition* which represents the description of 'conditions' designed to prevent the perceived risks.

Susskind appears to place greater emphasis on the antecedent perhaps because he is more interested in the general legal issues than the narrower area of regulations. His analysis of the legal production sets out to identify the full range of facets applicable to questions about legal productions and includes references which are more related to general law.[32] His framework reflects the division of a rule indicated by the systems model, but the implications for internal structure are not accounted for due to his focus on non-technical law; wider arguments associated with jurisprudential issues; and the shape of material with which lawyers operate.

The aim of his work is to investigate the codification of legal concepts into expert systems which can act as a deductive legal inference engine. In doing this he has thought it necessary to cover a wide range of topics which do not impact directly on the regulatory process. Nevertheless his views add further confirmation of the overall structure proposed by final version of the model.

4.8.2 Gardner's view of issue spotting in case law

Another investigator into the possibilities of using AI to handle legal problems is Gardner.[33] Her emphasis is quite different to that of Susskind, although both discuss the issues of hard and easy cases and come to different conclusions about how the differences may be revealed by computer analysis. Her emphasis is on ways of looking at the structure of law in order to describe situations and discover the key issues where possible, by using easy cases as a test for the suitability of the model. Her work is also concerned with

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32 [ibid. p.131]

33 [Gardner87]

general law and focuses on the structure of statements particularly in relation to contract law because it represents a well-bounded topic. She uses an augmented transition[34] network for testing events to discover if a contractual relationship exists between two parties. This method focuses on events leading up to the dispute involved in a contract, and is very specific to the contract situation.

4.8.3 Cotterrell's sociological perspective

Cotterrell in his work *The Sociology of Law* provides the following illustration (see Figure 4.5) which provides a different view of regulations as part of law in the context of relationships with other subsystems of society.[35]

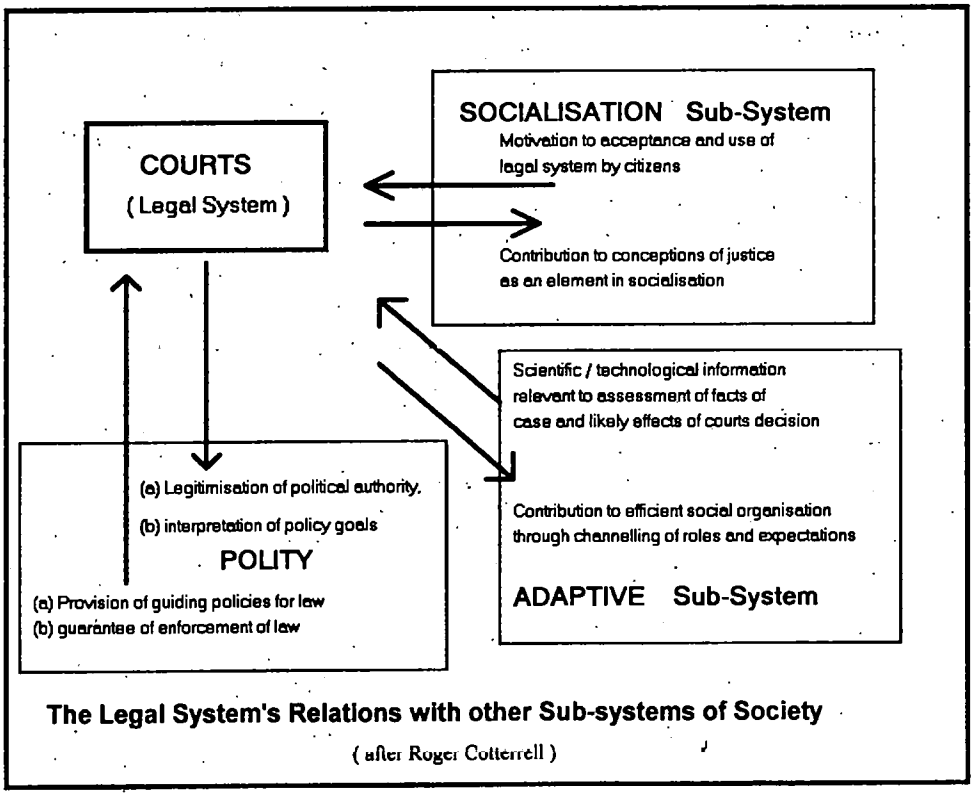

FIGURE 4.5

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34 see section 8.4.2 below

35 [Cotterrell84 , p.94]

A section of his work deals with what he regards as the accepted difference between real crime and regulatory offences controlled by regulatory agencies.[36] He refers to three categories of regulatory style: discretionary; mechanical; and particularised; and focuses on the gradual transfer towards ever-increasing discretionary regulation guided by general policy considerations. He observes that "discretionary regulation is thus often associated with the dominance of substantive legal rationality". This differs from the arguments presented by Schauer by putting forward the view that discretionary regulation is not rule-based. Cotterrell's work is useful in highlighting a number of the key issues in the interface between control and regulation. He describes mechanical regulation as that which:

> "seeks to accelerate or simplify the disposition of cases by removing some of the legal complexities of proof responsibility, or by standardising penalties or by turning judicial procedures to a greater or lesser extent into routine bureaucratic procedures." [37]

Mechanical regulation is a process much more suitable to the use of Artificial Intelligence approaches to the law and would effectively support entrenched rule-based decision-making as described by Schauer. Cotterrell also draws attention to particularised legislation, referring to legislation directed towards (i) particular topics or limited groups of subjects exemplified by technical regulations and (ii) those where particular legal statutes are identified for individual circumstances. He quotes employees, trade union members, consumers, welfare recipients etc. in this context which suggests that these features are a starting point for re-examining the landscape of the regulation agencies. Cotterrell writes that:

> "one of clearest lessons to emerge from the studies of regulatory agencies is the difficulty of isolating law enforcement activities or objectives from much wider tasks and aims".[38]

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36 [ibid. p.285]

37 [Cotterrell84. p.174]

38 [ibid. p.274]

From arguments based on this theme it is clearly important to recognise that method of enforcement may influence the form of the regulations - (discretionary, mechanical or particularised). Questions of performance are likely to be closely connected with thoroughness of monitoring and success of prosecution etc. For example, it appears that the style of enforcement and inspection carried out by the alkaline inspectorate differs significantly from that of the Health and Safety Executive and also from the building control environment.[39] Cotterrell points out:

> "the assumption is thus that despite the difficulties of deterrence theory as applied to ordinary criminal behaviour business organisations act on rational calculation and therefore take account of legal sanctions in assessing the cost of their actions"[40]

A point of importance for the function of the constraint mechanism is the differences between regulatory agency work and police work. This is where the authority to set interpretative legal 'standards' of behaviour for the regulated (in the sense of definitions of the limits of permissible conduct) is often passed on explicitly to regulatory agencies in a way which is not done with the police.

> "The orthodox justification of this is that, where regulatory agencies are concerned with the control of complex technical industrial practices, norms of appropriate business behaviour must be framed and interpreted in the light of specialised and changing technical and scientific knowledge." [41]

Cotterrell then extends the discussion to political and commercial pressures, which may be operating to influence the application of legal controls. Although outside the scope of the current study it is clearly a factor to be considered in terms of performance of regulations. In his comments on real crime and regulations he states that

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39 [Hawkin94]

40 [Cotterrell84. p.276]

41 [ibid. p.278]

> "the existence of extensive agents of discretion in law enforcement, coupled with the authority which many agents have to establish regulatory standards, creates a situation in which enforcement practice determines the *effective meaning* of law for the regulated."[42]

4.9 CONCLUSION

Essential features of a regulation's requirements can be identified and compared at different stages in their application by tracing the development of a specific theme. This supports greater precision about apparent inconsistencies in, for example, changing attitudes to control over food storage.

A great deal of commentary regarding the regulatory process depends on the standpoint of the writer, and frequently uses terminology that varies from one writer to another. The model offered here is put forward as a first step in distinguishing the different concepts and arguments. The aim is to obtain a clear framework for discussion about function, performance, and internal structure of regulations having examined the principal relationships between the key elements and outside influences.

Each of the actors in the system model put forward here has different experiences in the application of the building regulations. Each has to cope with varying levels of uncertainty regarding the 'real' meaning behind the individual clauses. The knowledge of building control officers is at the highest level and yet there are substantial differences in interpretation from one to another. Some seek to apply the exact wording of a clause whereas another may look to the original justification to achieve a compromise solution.

Regulations are created and exist in an environment of considerable variability in personal knowledge, experience, and aims. From conversations with Building Control Inspectors,

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42 [ibid. p.285]

builders and other architects, the writer believes that making regulations more accessible and easier to understand will benefit all members of the construction industry by saving time. This should in turn benefit members of the general public by reducing costs.

CHAPTER 5 THE BUILDING REGULATIONS

Abstract

This chapter describes a specific example of regulations - The Building Regulations 1985, to expand on the previous chapter. Its history is described, together with its relationship to other legislation, and to similar regulations in other countries.

These themes are used to illustrate how styles of regulations can vary, and to suggest those features that may need to be present in a model of internal structure.

An example clause is examined under the headings of the principle components of the system model; providing a prelude to the next two chapters dealing with information obtained from problems experienced in the application of regulations.

5.1 INTRODUCTION

5.1.1 Chapter outline

The previous chapter proposed a systems model, using The Building Regulations as example, to clarify arguments about influences that apply to an individual regulation, or set of regulations. The model illustrates relationships between the principle components and depicts the main points raised in Chapter 2 about technical prescriptive rules embodying sanctions.

The lengthy development of regulatory processes for the building industry, traceable back to the Public Health Act of 1848, provides a suitable background for this investigation because they have been extensively documented. Furthermore, the research has been assisted published reports on appeals and determinations dealing with points of detail that have been disputed within individual clauses. This chapter deals with a particular version of *The Building Regulations 1985* and its amendments through to the introduction of a revised set of regulations, which came into force on the first of June 1992. It provides the context for discussions, which follow in succeeding chapters, and is illustrated by the components of the systems model. It is recognised that other sets of regulations may have differences in how successfully they are depicted by the systems model. The history, the current situation of the Building Regulations, and how different degrees of detail are applied to individual clauses through the mechanism of the Approved Documents are discussed. Building control in France and Germany is described briefly to show how objectives vary. One section of the regulations, Part G, dealing with 'Hygiene' is described to show the components identified by the systems model and to consider issues of risk.

5.1.2 The Building Regulations 1985

The Building Regulations 1985 was made by the Secretary of State for the Environment using power vested in him by section one of The Building Act 1984, which defined the enabling framework. The Act states that building regulations may be made for the following purposes:

> A securing the safety, health, welfare, and convenience of people in or about buildings and of others who may be affected by buildings or matters connected with buildings.
>
> B furthering conservation of fuel and power.
>
> C preventing waste, undue consumption, misuse or contamination of water.

The regulations were presented in a new format - short - and containing little technical detail. They are expanded upon in a series of fourteen Approved Documents and certain other non-statutory guidance. All of these refer to other non-statutory documents, such as

British Standards and Codes of Practice with the aim of making the regulations more accessible and easier to use.

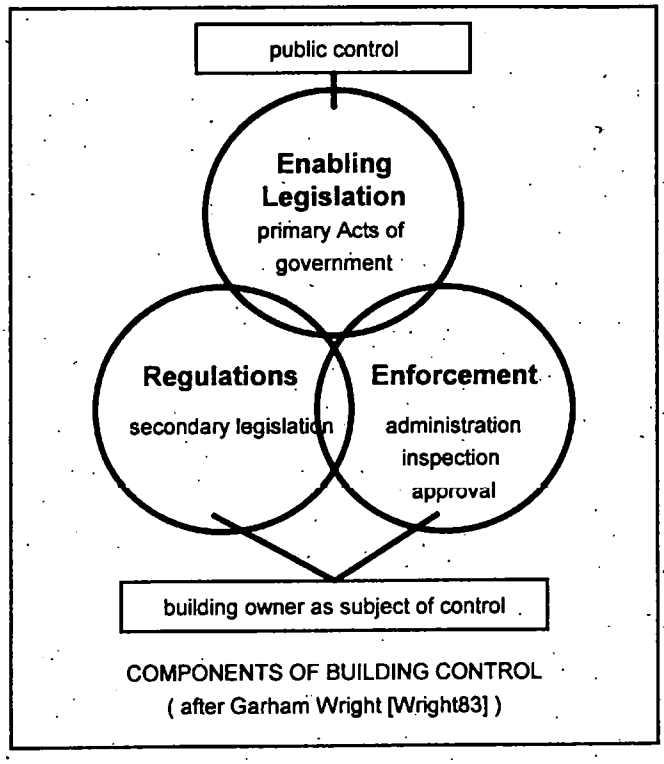

FIGURE 5.1

The relationship between *The Building Regulations* and the method of enforcement is illustrated in the systems model. Given the environmental and political factors which shape the legislation, the regulations and compliance procedures are the two parts of the control process, each allowing for the procedural nature of the other. *The Building Regulations 1985* depends heavily upon accepted general codes of conduct and industry conventions. They affect both the meaning of the situational specification and response definition implied by the regulation, and also the amount of detail thought necessary to obtain a required outcome. These factors are of particular importance when considered over a period of time as new working methods, living standards, society's evolution and so on, modify the overall environment in which regulations take effect.

5.1.3 Interaction with other legislation

The Building Regulations 1985 is part of a framework of legislation, which places limitations on the ways in which constructional work is carried out in this country. Its domain of influence can be compared with the most immediate related legislation by reference to the following table:

Type of Control	Legislation	Responsible Body	Superior Body	Technical Specifications
Use and Development of Land	Planning Laws and regulations - GDOs[1]	District Council plans Committee	Secretary of State	Dept Circulars PPGs Local Plans
Design and Construction of Buildings	Building Act and Building Regulations	District Council [Building Control Officers]	Secretary of State construction dept	Approved Documents and related BSs
Occupancy of Buildings	other legislation relates to particular occupancy e.g. (safety of sports grounds)			
i) Fire Safety	Fire Precautions Act	Fire Authority	Home Office	HO guides and related BSs
ii) General Safety and Health	Health and Safety at Work Act etc. & Regulations	H & S Executive	Dept of Employment	HSE Reports and related BSs

Current Regulatory Systems set out by Atkinson (after BRE) [2]

(Relating to the use and development of land, and design, construction and occupancy of buildings in England and Wales)

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1 General Development Orders

2 [Atkinson93, p.131]

5.1.4 Styles of regulation

Different styles of regulation have been adopted to suit different industries and evolving methods of enforcement. Currently there is pressure for change to the regulatory process, to harmonise the way European governments regulate design and construction of buildings.

Atkinson describes some of the trends:

> "To achieve the aims of an essential requirement, control over products and their incorporation in the initial construction is but one stage in a process of control and surveillance. Present regulatory systems may have to be updated to take account of more complex buildings and a wider range of responsibilities, involving many different participants, during the construction, design, use and reuse decision processes. Reference may have to be made to 'approved documents' such as technical codes and specifications, many of which will be harmonised at a European level."[3]

It is suggested here that variations in styles of regulation are likely to impact in various ways upon the structures contained within them. However, it is outside the scope of this study to determine whether such variations can be identified from one body of regulations to another. It is considered sufficient to achieve the research aims to base the dissertation on one single body of regulations as an example. The object of the present study is to provide a framework against which clause structure (among other things) can be shown to connect back to superior legislation.

This present chapter shows how adjacent legislation is integrated into the control of building construction.

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[3] [ibid. p.138-39]

5.2 HISTORY OF THE BUILDING REGULATIONS

5.2.1 Early history

A detailed account of the history of building control in this country is not relevant to this dissertation. Nevertheless, to appreciate how issues of context are implied and transferred into clauses of a regulation, it is worthwhile establishing some understanding of how and why the regulations have been created, and how perceptions of need have evolved over time.[4] How the focus of the regulations has changed and expanded is illustrated by reviewing the development of the regulations. The history of modern building legislation goes back to 1845 when the first Public Health Act was passed. It was a reaction against concentrations of housing in inner cities and the defects being addressed were damp, structural instability, poor sanitation, fire risk, and the need for adequate light and ventilation. It was considered a public duty to reform these conditions in order to establish better living conditions for the poor.

5.2.2 Public Health Act 1875

Towns in the provinces were, by this time, also becoming concerned about building control and the Public Health Act 1875 brought in general powers to control construction by means of byelaws. Local authorities were empowered to make byelaws designed to protect the interests of health including; air space about buildings; ventilation; drainage; water

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4 In his review of the history of the discipline of building standards, Entwisle mentions that around 2000 BC regulations were introduced requiring the death of the builder in the event of the death of any man due to the collapse of a building. He also mentions that in this country the great fire of London gave rise to the introduction not only of a code of regulations primarily to guard against the outbreak and spread of fire, but also the appointment of individuals to see that such rules were carried out. This was the start of the London district surveyor system. Stephenson [Stephenson1993] however, refers to the start of building control in this country as beginning in London in 1189, when regulations relating to party walls, rights of light, drainage and related matters were made. Fire resistant construction and rudimentary means of escape in case of fire were also subject to regulation at the same time.[Entwisle74]

closets; earth closets; and cesspools. These powers were further extended by an amending act in 1890 to include control for provision of flushing of water closets, determining height of rooms intended for human habitation, ensuring paving of yards, open spaces around dwellings and the provision of backyards to facilitate the removal of refuse. Model byelaws were issued by the Ministry of Health at this time and but councils, although basing their own byelaws on this model, developed their own versions resulting in a considerable lack of uniformity.

5.2.3 Public Health Act 1936

In 1936 new legislation was enacted covering all buildings and requiring all local authorities to make and enforce building byelaws. At this time, although guidance from central government was available, local authorities were held directly responsible for building standards based upon their own interpretations of general government guide-lines. In 1952 *Model Byelaws series 4* saw two further advances. Firstly, a different technique for control was used, whereby standards of performance were stated, and these formed the mandatory section of the byelaws. "Deemed to satisfy" provisions were added, leaving the way open for newer methods and materials to be used providing their satisfactory performance could be established. This system has been expanded upon since that time and has provided for increasing reference to advisory publications such as British Standards Specifications and Codes of Practice. In addition, although the enforcement of the model byelaws was left to the local authorities they were universally adopted throughout England and Wales, except by the LCC, and in this way control legislation became standardised.

5.2.4 Public Health Act 1961

In an effort to achieve greater uniformity and to deal with advances in techniques and materials, the 1961 Act took powers to make building regulations nationally. This was a significant change in the law relating to building construction because it took away from

local authorities the power to make building byelaws. The new procedure enabled the ministry to make building regulations through statutory instruments having universal application throughout England and Wales. Broadly they were designed to achieve similar aims to the previous Public Health Act, but the new legislation made a single authority responsible for their issue. The first building regulations under the new legislation were made in 1965, coming into force on the first of February 1966, with many subsequent amendments required to make the new system work effectively. The regulations were metricated in 1972 and there were regular alterations and additions up to the introduction of a completely new format for the regulations, in November 1985. However, the content of the situational specification and response definition in the new regulations did not change at this stage.

5.2.5 Health and Safety at Work Act 1974

The Health and Safety at Work, etc., Act 1974 dealt with a large number of issues of which more than one third related to building regulations. This provided for the scope, purpose and coverage of building regulations to be amended, with changes to procedures intended to give greater flexibility. This tidied up some of the problems relating to the existing system of controls extending their scope to include electrical and other building services, water fittings, and access for disabled people. It also made it possible for a number of other structures and erections, for example radio and television aerials to be subject to building control. The new regulations also provided for plans to be approved in stages and powers to be given enabling building regulations to impose continuing requirements on owners and occupiers, for example, ensuring that lifts are maintained in good operating condition. However, not all of the new requirements in the act came into operation immediately, but relied upon the Secretary of State to make "commencement orders" bringing various parts of the Act into operation at appropriate times.

5.2.6 Miscellaneous Acts

Between 1974 and 1984 there were a number of miscellaneous acts[5] dealing with the introduction of fees for inspection of plans and or buildings, and particular types of specialist buildings. There was also an attempt, early in 1984, to introduce reforms to building control by providing supervision of plans and work by bodies other than local authorities. Certain exemptions and relaxations from procedural requirements were granted for public bodies; and provision was made for "Approved Documents" giving guidance to building regulations.

5.2.7 Building Act 1984

Earlier legislation passed in 1984 was replaced by a new act later in the same year, which consolidated building control statutes enacted over the last 90 years. This Act is the statute under which building regulation is carried out in the UK. Most of the enactments concerning buildings and related matters were re-stated in the 1984 Act and a large amount of past legislation repealed. It consisted of 135 sections and 7 schedules dealing with matters ranging from the introduction of approved documents, to tests for conformity with building regulations. The widening of scope of building control under the Health and Safety at Work Act was transferred to the 1984 Act.

The range of matters over which the Secretary of State is empowered to make regulations covers: design and construction of buildings, services, fittings and equipment associated with buildings. It is defined as relating directly to the health, safety and welfare, and convenience of persons in and about buildings, and in addition, conservation of fuel and power. The Fire Precautions Act 1971[6] also provided for regulations to be made in connection with fire escapes. The range of matters that in practice the regulations cover

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5 [B(PF)R80], [LGA82], [HBCA82].

6 [FPA71]

extends from the preparation of building sites through to the storage and removal of waste. It included provision for access of disabled people to buildings and deals in extensive detail with administrative procedures for obtaining approval.

Since the Act was passed there have been three important Statutory Instruments: *The Building Regulations 1985*; and significant amendments in 1991, and 1994. This investigation is confined to the application of *The Building Regulations 1985*. In contrast to previous regulations, which were contained in a single mandatory document, the statutory instrument made under the Act was much shorter relying on the Approved Documents for explanation. *The Building Regulations 1985* was divided into five parts.

The main requirement, regulation 4 stated:

> "(1) building work shall be carried out so that -
>
> (a) it complies with the development requirements contained in schedules 1 and 2 and
>
> (b) the method of complying with any such requirement does not result in the failure of any part of the building work to comply with another such requirement.
>
> (2) Building work should be carried out so that, after it has been completed -
>
> (a) no building which is extended or to which a material alteration is made,
>
> (b) no building in or in connection with which a controlled service or fitting is provided, extended or materially altered, and
>
> (c) no controlled service or fitting, is adversely affected in relation to compliance with any relevant requirement by Approved Documents which give examples of construction which can be considered to comply with the regulations. "

A manual giving explanatory notes and 13 Approved Documents, each of which contains guidance on the implementation of the relevant regulation, supported the regulations. In addition there was a schedule dealing with facilities for disabled people, and a Code of Practice giving requirements for means of escape in the case of fire.

5.2.8 Additions and Alterations

Between the implementation of *The Building Regulations 1985*, and the major revision in 1991, (the end of the period considered by this dissertation), there were a number of further developments.

The Building (Inner London) Regulations 1985[7], applying the national system to London from the 6th January 1986.

The Building (Disabled People) Regulations 1987[8], replacing schedule 2 with the new part M.

The Fire Safety and Safety in Places of Sport Act 1987[9].

The Water Act 1989[10], setting out a framework of new bodies to be responsible for water and sewage services following privatisation.

Local authorities have exercised control over buildings in England and Wales since 1189 but it was not until 1965 that the uniform system was made to apply throughout the country apart from inner London. *The Building Regulations 1985* applied in inner London early in 1986.

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7 [B(IL)R85]

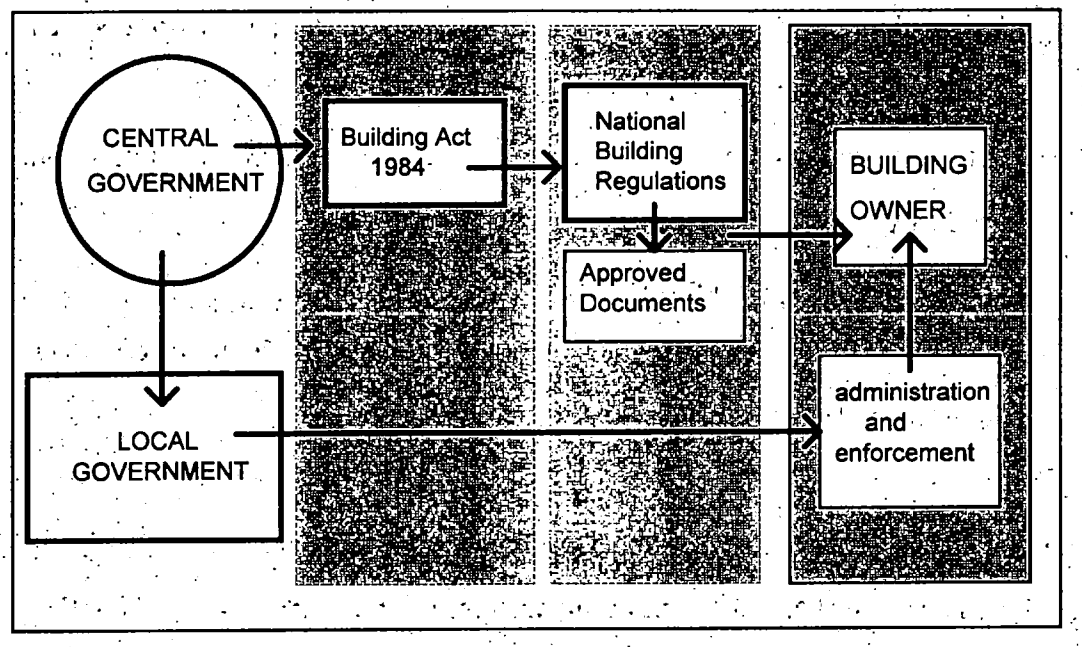
8 [B(DP)R87]

9 [FSPSA87]

10 [WA89]

5.3 THE BUILDING REGULATIONS 1985

The Building Act and associated regulations are part of a system of control relating to the use and development of land, and the design and construction and occupancy of buildings in England and Wales illustrated as below:



UK SYSTEM OF BUILDING CONTROL

FIGURE 5.2

5.3.1 Approved Documents

As can be seen from the above diagram, the Approved Documents form a major part of the regulatory process. They make it possible for the executive regulation clause to be brief. For example, regulation K1 is one of the shortest; "stairways and ramps shall be such as to afford safe passage for the users of the building". This is supported by an Approved Document with 6 pages of technical explanation and diagrams. The significance of this is that the 'response definition' (the description of features used to describe the controlled object), and the constraint boundaries are amplified by a large number of subsidiary clauses, each of which deals with a particular aspect of the clause within the primary regulation. The purpose of the Approved Documents is to describe forms of construction

which are deemed to comply, but the regulations do not require that construction conform exactly to the specification given. Approved Documents give practical guidance about some of the ways of meeting the requirements of the regulations. Their regulatory function is that following the guidance in the document is evidence tending to show that construction complies. In practice, therefore, the easiest way of obtaining approval is usually to comply with the techniques, dimensions, materials or Levels of Performance set out in the Approved Documents.

5.3.2 Enforcement

Prior to carrying out work it is necessary to obtain approval from the local authority to the proposed forms of construction. This may be done either, by submitting a 'Building Notice' to indicate that construction work is to commence, or by depositing full plans. One of the government's aims in reforming the previous method of building control was to provide an opportunity for self-regulation by the construction industry through a scheme of private certification. This was not intended to be a complete replacement for local authority control, because the Local Authority remained responsible for taking any enforcement action that became necessary. However, a developer was given the option of having work supervised privately. This meant that the responsibility for ensuring compliance with *The Building Regulations* could, at the option of the person intending to carry out the work, be transferred to an approved inspector empowered to issue a certificate of compliance on the completion of the works, instead of the local authority.

The method of enforcement has significance for the structure of the regulation because it has evolved over more than a century by relying on the established practice that there will be local interpretation by the enforcing authority. Regulations do not need to be designed to cover all possible circumstances. In order to carry out the desired controlling actions those drafting the regulations have to take into account a situation in which the regulation defines the main parameters, leaving it to the enforcing authority inspector to make the final decision. How much a regulation system can depend upon individual interpretation

is explored by Schauer in considering whether a rule can still be considered to be a rule, when the effect of the original justification is modulated by enforcing individuals. This is an important question in the debate about systems of control and different regulatory strategies. It is possible to see the effect of applying discretion in the reports of Appeals and Determinations, where only the Secretary of State and his department are involved. In determining the underlying structure of regulations it would be a reasonable aim to determine the extent to which local interpretation can be carried out without prejudicing the original justification.

5.4 STYLES OF CONTROL

5.4.1 Main styles

Despite significant reform over the last 30 years, building regulations still contain examples of three main styles of control in the way in which the regulations are expressed. These are put forward by Wright[11] as the principal options for specifying the requirements of a regulation. The following table describes these:

STYLE	METHOD	CHARACTERISTICS
Specific	exact description of construction required	Easy to understand, but allows no alternatives
Functional	states aim or purpose without detailing exactly what is to be done	Some freedom to chose solution but can be obscure because standards are only implied
Performance	defines performance in objective terms which are measurable	Easy to check for compliance but requires high skill levels by all concerned, particularly in measurement and testing.

11 [Wright83 p. 82 - 104]

12 [Wright83 p. 82 - 104]

A report to parliament in 1964 identified three legislatory techniques that exist for the purpose of giving force to mandatory requirements. These were named as specific, functional and performance standards. All were then in use and remain so 30 years later, reinforcing the point made in the report that there would be "room for a long time for all the variations and combinations of them". One of the questions which arises out of the three alternative modes of expression is whether each of these differences is at a superficial level, or whether there is some change to internal structure reflecting the different ways of defining the stipulated conditions for compliance. This question is an opportunity for further research outside the scope of this dissertation. A further question is whether different styles might show differences in the constraint mechanism by perhaps setting increasingly quantified 'hard' limits.

5.4.2 Different styles in Germany and France

The classification given above can be compared with the approaches by different European countries to what is fundamentally the same problem of controlling construction. Examples show alternative methods from two European countries, Germany, and France. Atkinson points out that both countries have systems depending upon technical direction by an "elitist professional bureaucracy". [13]He points out that they both have legal systems based on a civil law approach derived from Roman law and with a written constitution.

He suggests that German building regulations derive from attempts to mitigate the effect of disastrous fires and pestilence, being influenced by the Prussian concept of the state's direct responsibility for public order. The German system relates back to 'DIN' standards placing emphasis on control by authorities and leaving less responsibility to the constructors. There is strict control during the construction process, checking of designs by an independent engineer and careful technical site inspection, with much attention given to

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[13] [Atkinson93, p141]

final inspection to uncover deficiencies.

Atkinson points out that the French system, on the other hand, can be seen as aiming to provide consumer protection by placing greater emphasis on responsibility by the constructors and with importance based on damage insurance. Initial approval for buildings to proceed requires permits issued against the signature of an architect confirming that the building meets the necessary regulations, with the possibility that a government engineer can check compliance during the first three years after completion. There are mandatory requirements for independent technical control for what are seen as high-risk situations such as tall buildings and deep excavations. The French emphasis on insurance is interesting since in the UK insurers play only an indirect role in influencing building standards.

In this country, the attention of most insurance organisations is directed towards the insurance consequences of costs incurred in court cases where liability issues are fought out. John Mead[14] gives a view of the insurance industry's role by emphasising the obligations of approved inspectors and the legal consequences, which may follow from a claim for negligence, possibly involving case law. In this situation questions of a much broader nature are more likely to be encountered than by considerations of technical regulations alone. Such issues of responsibility are considered part of general law, outside the scope of this dissertation.

5.4.3 Performance

There has been very little public discussion about the performance of the regulations as a control process despite the large number of commentaries on the building regulations.

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14 [Mead91, p. 35]

15 [Mead91, p. 35]

Explanatory publications concentrate on explaining the method of operation of building regulations and elaborating on fine points of technical detail. In a letter from the Department of the Environment dealing with the review of the building regulations in 1986 the main objectives of the review were described as simplification and the reduction in the amount of control exercised under the former regulations.

The document[16] states:

> "There are indications that in a number of respects the new form of the regulations is proving successful. There has been a general welcome for the Approved Documents and there has also been a large reduction in the number of disputed cases being referred for decision to the Secretary of State. In the first year of operation just under 200 applications for determinations and relaxation appeals were received, compared with over 1,000 each year under the previous regulations. The Department proposes to ask consultants to report during 1987 on the way in which the new regulations are operating"

In general there appears to be no attempt to assess the performance of the regulations in the wider context of whether they are successful in achieving their objective. However, some measure of risk assessment is now being introduced.

5.5 REASONS FOR CONTROL

5.5.1 Purpose

In his book Entwisle described the objectives for a legal code of building standards as follows[17]:

> "At the present time it could be said there are two basic reasons for a code for regulating building standards. The first, to force the careless and unwilling to build to a standard considered by society as the minimum acceptable in the interests of public health and safety; it is accepted that as a civilisation develops, standards become higher and wider in their scope.

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16 [DOE86]

17 [Entwisle74, p.26]

> The second is to provide a national guide to developers to assist them in the preparation of building designs and in carrying out the actual construction of building, so that not only can they be assured that they are building to an acceptable standard, but that in a competitive environment all developers have to meet the same requirements."

The question of purpose, of major importance to persons involved in the interpretation of any group of regulations, brings us back to the difficult issue of determining the original justification. At the highest level "the safety and protection of persons in and around a building" is so general as to be of little direct value in interpreting individual clauses. At the next level down the requirements of each clause, in many cases, echoes in a general sense the section heading, such as 'safety' or 'hygiene', in order to explain the reasoning behind the controls being imposed. There are no other clues given in *The Building Regulations* or the Approved Documents regarding purpose and this omission is made more obvious when regulation clauses are encoded into the frame format designed to represent their internal structure. Purpose, therefore, remains a rather obscure aspect of many regulations.

5.5.2 Building features

The construction of buildings has certain characteristics:

1) buildings are mostly one-off products, erected on a piece of ground which is unique and which may vary in quality every few metres.
2) buildings last for a long time, often centuries, and parts of buildings may have to be replaced at different times. Defects may remain latent for many years and remedial work may be difficult for a variety of reasons.
3) design work is often split between different practitioners, and construction workers move from site to site. Identifying responsibility and enforcing quality are two difficult issues to resolve.
4) supervision and inspection on construction sites is usually unsystematic
5) while structural engineers, and more recently environmental services engineers, give much time to the development of design codes taking risk into account, it is

not easy to introduce this knowledge into regulatory systems which do not distinguish between levels of practitioners.

In commenting on these special problems Atkinson makes the point: "Today little has been done to monitor the effectiveness of the methods adopted by authorities to achieve the objectives of their building regulations and other legal requirements, despite the fact that it is an essential precondition for their harmonisation and simplification."[18]

Despite the difficulty of defining the purpose behind individual clauses, and the absence of a feedback process monitoring their performance, regulations continue to be imposed by statute and tend to become more complex with new versions. A great deal of reliance is placed upon them, however, because of their important role in setting the agenda for determining acceptable construction standards.

5.6 COMPARISON WITH THE SYSTEMS MODEL

5.6.1 Examples

Part G of schedule 1 to the Building Regulations 1985 has four clauses :

Food storage

G1 "There shall be adequate accommodation for the storage of food or adequate space for the provision of such accommodation by the occupier."

Bathrooms

G2 "a bathroom shall be provided containing either a fixed bath or a showerbath, and there shall be a suitable installation for the provision of hot and cold water to the bath or showerbath.

Hot Water Storage

G3 If hot water is stored and the storage system does not incorporate a vent pipe to the atmosphere, there shall be adequate precautions to:

(a) prevent the temperature of the stored water at any time exceeding 100deg.

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18 [Atkinson93, p.154]

C: and

(b) ensure that the hot water discharged from safety devices is safely conveyed to where it is visible but will cause no danger to persons in or about the building.

Sanitary Conveniences

Regulation G4 Sufficient sanitary conveniences shall be provided which shall be-

(a) in rooms separated from places where food is stored or prepared; and

(b) designed and installed so as to allow effective cleaning.

As these stand they vary slightly in the degree of specification detail given but are functional in style in that they clearly state what is required to comply with each clause. Terms are expected to carry a generally accepted meaning and they rely on the Approved Documents to explain "adequate".

5.6.2 Assessment of risk

Apart from G3, this part of the regulations shows its roots in earlier public health acts, and raises the question of why other issues relating to hygiene are not addressed by the regulations. Current food technology and sanitation expose us to a wide variety of risks from microwave cooking to concentrations of harmful chemicals in waste pipes. However, none of these has created an alarming enough public scare to cause the Department of the Environment to draft regulations to deal with the problems. This may therefore be a reflection of a pragmatic approach to avoiding unnecessary legislation. T. A. Field, Superintendent Architect, Building Regulations Division of the DoE, in an interview[19], explained that the Department was now considering problems with buildings in terms of statistics indicating potential numbers of accidents from different causes. For example, figures indicate that the likelihood of deaths attributable to radon is in excess of 2,600 p.a., which is greater than possible deaths within buildings from all other risks put together.

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19 [Field94]

The figure for deaths on staircases is less than 10 p.a. Risks from structure are of a similar order as are actual deaths from fire. As a result of this new approach to regulations arising out of actual risk, a new section ("N") has appeared in the latest building regulations dealing with hazards created by glass. However, from conversations from members of the Department[20] it is clear that vested interests make it difficult for entirely new bodies of legislation to be brought into effect and in practice a threat of possible legislation is an important educator to control industry. This experience appears to be borne out by other bodies of legislation dealing with environmental pollution .

5.6.3 Detailed example - pressure for regulation and change

An example clause in *The Building Regulations* and relevant Approved Document is now compared with the system model to draw out certain features of content and constructional style. Referring to G1, quoted above we can see that the clause comes within 'Part G - Hygiene' giving a general indication of purpose and indicating the focus of interest for the section within the overall body of the regulations. The limits of application are defined in an adjacent note as "This requirement applies only to dwellings." (an appraisal of an earlier version of this regulation, in the previous chapter, may be compared with the analysis of the newer version below)

This clause is expanded further by the Approved Document under the heading "Acceptable Level of Performance" as follows:

> "To reduce the risks to the health of persons in buildings, any dwelling should have a food store or space for the provision of a food store which is:
>
> a. of sufficient capacity and
>
> b. capable of being ventilated or refrigerated and
>
> c. easily accessible for preparing food. "

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20 [Field94], [Bovill93] and [MacPherson93]

5.6.4 The situation and justification

The situation being defined (the situational specification) is; 'if a dwelling is being constructed'. This regulation is justified within the context of lingering concerns about situations which the public health acts of the 19th century were designed to prevent - overcrowded housing, and illness associated with lack of facilities for hygienic storage of food. The system model shows how this generalised pressure to regulate relates to the controlling body and the perceived risks. In the section giving definitions as a guide to interpretation "dwelling" is defined as including a dwelling house and a flat. It is stated that "dwelling-house" does not include a flat, or a building containing a flat. The definition of "flat" is much longer; "flat" means separate and self-contained premises constructed or adapted for use for residential purposes and forming part of a building from some other part of which it is divided horizontally". A generalised notion for the meaning of "residential" is assumed, although with changing living patterns it is possible to foresee some room for disagreement about the exact activities covered. There may in time be case law to resolve this issue.

5.6.5 Required conditions - the response definition

In this regulation, control is aimed at maintaining certain minimum standards on behalf of society. These are specified, as conditions deemed necessary to achieve a dwelling with proper facilities; forming the response definition.

More exact specifications for capacity and ventilation are given in the Approved Document as follows:

> Sufficient capacity - a food store shall have a total capacity of at least 1.75 square metres, which may be reduced to 0.75 square metres if the dwelling has only one bedroom. Clause 1.2 states that if in multiple occupation it should have at least the same provision as a dwelling and the provision should be accessible to all occupants.

Ventilation - dealt with by the provision of an openable area at least 300mm by 300mm to provide natural ventilation. A durable flyproof screen taken directly or ducted to outside air should cover this. Ducts to have an internal area equal to at least 125 by 125 mm of smooth surface.

If a refrigerator is provided as an alternative there must be a13 amp electricity supply or a gas point within the space provided for the refrigerator.

It should be noted that (c) "easily accessible for preparing food" is not elaborated upon. The entities being controlled are identified as part of the response definition and the required features for each are given in sufficient detail to create conditions considered acceptable for construction. Supplementary provisions are added to cater for specific additional circumstances which may require control, as for example, the provision of a durable flyproof screen and the alternatives of direct or ducted connection to the outside air.

5.6.6 Changing attitudes to risk

There have been no recorded appeals or determinations in respect of this regulation. It is interesting to note that this particular clause was deleted from the 1991 version of the regulations. The current situation, therefore, is that housing is now being constructed, with a possible concern that, even today, in high density housing there may be a risk of being housed in one or two rooms without such minimum facilities. In effect the threat of disease or food poisoning is now being regarded as of sufficiently low risk as no longer to warrant a specific regulation. The Department of the Environment states that the reason for the removal of the regulation is the universal use of refrigerators making the requirement obsolete and that risks to health are no longer considered to emanate from problems associated with storage of food.

5.7 DEGREE OF DETAIL WITHIN CLAUSES

5.7.1 Vagueness

It is at the point at which disputants invoke "the spirit of the regulations" to support their argument that special difficulties of interpretation arise. Safety, risk, and hygiene become fuzzy concepts under close examination, inviting comparison with examples drawn from outside the building industry, such as traffic regulations or non-smoking rules in public areas. The way in which business enterprises operate harmoniously within a rule-based environment appears to vary from industry to industry. It is widely accepted within the construction industry that the gas industry achieves its relatively good safety record because of rigorous enforcement of very stringent safety standards. People within that industry take pride in working "by the book" and this is paralleled in the electrical industry by the careful detail set out in regulations for electrical installations published by the Institute of Electrical Engineers. The regulations in this latter document are of a highly technical nature leaving little room for ambiguity. For example, p551-2 states: "step-up autotransformers shall not be connected to IT systems". Tables are provided for selections of cable sizes to carry varying loads with upper and lower limits precisely defined. The document reflects the mathematical nature of electrical engineering, in contrast to the building regulations, which exist to control a craft-based industry.

There remain adverse situations, which arise in buildings, which are not prevented by the degree of specification within the building regulations. However, it has become a convention, accepted by the industry, that they provide an agenda for negotiating solutions acceptable to the developer and the Building Control Department of the Local Authority. Both sides discuss conventional materials and techniques, and building inspectors will usually confine approval to "normal" solutions with which they are familiar. They have discretion to accept a form of construction, which in their view meets the spirit of the regulations.

5.7.2 Multiple levels of control

It is suggested here that, in their present form, building regulations work at four levels. At the highest level, the Building Act states that the Secretary of State may make regulations concerned with the safety of persons in and around buildings. At the next level the Department of the Environment under powers granted to it by the Building Act produces *The Building Regulations*, a Statutory Instrument putting legislation into effect. This expands the general intention into particular topics dealing with, for example, hygiene and the provision of food storage. At the third level, the Approved Documents describe forms of construction that will be regarded as complying with the building regulation requirement. The details within the Approved Document take each clause and give more information about the constraints and what process or construction will be deemed to be acceptable. At the lowest level there is the enforcement process ensuring standards are maintained by granting approval. The method of enforcing compliance in this way is declining as new bodies of regulations come into force in which compliance is assumed until something goes wrong. The burden of proof of compliance then shifts to the person or organisation responsible for the building.

5.7.3 Unvented hot-water systems

Regulation G3 - Hot Water Storage - was imposed because of potential risks to safety from overheating hot water storage vessels exploding as a result of a build up of internal pressure. New plumbing techniques coming into use during the 1970s caused concern about the desirability of permitting unvented hot water systems in domestic premises. This was partly a result of the traditional lack of direct regulation of plumbing work in the U.K. Importers in the past had made extravagant claims about the advantages of high-pressure unvented systems and the DoE considered it necessary to initiate some form of control. Assessment of the technology involved is described in an issue of [21] Building Control to

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21 Building Control - January/February 1986 lists the requirements of the Approved Document describing the

explain the reasons behind the regulation and their relationship with water byelaws.

This is a new subject for building regulation, dealing with an entirely new type of anticipated threat - a disaster arising out of overheating water being unable to escape safely. The control proposed is set out in great detail in the Approved Document requiring the manufacturer of the proprietary unit to meet standards imposed by the British Board of Agreement. Details are provided for thermal cutout, provision of temperature relief valves and their position within the storage vessel, method of installation, requirements for the discharge pipe. A general comment is given that a storage vessel with a low bursting pressure will be subject to a less severe explosion than a similar vessel with a higher bursting pressure.

Regulation G3 is a new regulation and it is interesting therefore to see how it performed. In the reports of appeals and determinations by the Dept of the Environment there have been three requests for determinations and in each case the Secretary of State has concluded that the proposals were not in conformity with the requirements of G3. A commentary published in the magazine Building[22] suggested that the regulation can confuse installation workers and compliance is difficult. Churchyard points to significant gaps in the specification of the proprietary unit and the possibility of using alternative types of water feed to the installations. He remarks that the Approved Document uses the word "should" throughout in referring to its stipulations, whereas the regulation requirement states "there shall be adequate precautions". He also suggests that the requirements of this regulation do not come into effect if the work being carried out within a building is only to the hot water supply system using certified equipment. No building notice order or deposit of plans is required and he comments that this is strange as it implies that less can go wrong

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technology and referring to the main risks of explosion if thermostats or over-heating cutouts fail.

22 [Churchyard91]

in an existing building than in one which is being built. This has now been rectified and the latest edition of the regulations has been extensively modified to take account of changes in the supply of the systems which originally emanated from America, where a large number of explosions were reported.

These examples indicate the sort of difficulties that can arise from a set of regulations, even one that has a long history of development and in an industry used to this type of control. It is clear that drafting the situational specification and response definition is far from straightforward. Furthermore it needs time for all parties to come to develop and accept entrenched generalisations as a basis for control.

5.8 CONCLUSIONS

Regulations for the control of building construction have a long history and for one and a half centuries have been part of the legislative framework in this country. They have evolved as a series of checks and balances to the disasters and risks associated with the use of buildings. As a consequence they are part of a process containing a wealth of documented examples of the evolution of the regulations and the problems encountered in their application.

The Building Regulations 1985 is a well-defined set of standards linked to an extensive collection of recommendations in the form of British Standards and Codes of Practice. The regulations themselves are succinct and in a compact form amplified by Approved Documents which contain a combination of specific, functional and performance stipulations. Although differing in form of presentation and methods of enforcement from examples taken from other countries they provide the basis for analysis to investigate questions about the existence of an underlying structure. Differences between types or regulations from different cultural groups could be used to reveal features assisting in the search for an answer to this question.

This review of a selected body of regulations has examined the range of material under consideration and which needs to be included in any structural representation. It suggests that the main issues are:

- the origins of the regulations under consideration and the important relationship with legislative context
- how this context will have become absorbed by the industry, culture, and conventions accepted in forming an interface to the enforcement agencies.
- the probability that a domain vocabulary is needed for effective communication about objects and situations.

Commentaries are available dealing with decisions by the Secretary of State about problems that are encountered during the application of regulations. These are considered to offer a suitable place to begin formal investigations for examining the proposition that there is an internal structure for regulations, which is consistent across alternative modes of expression.

CHAPTER 6 INFORMATION FROM DISPUTES

Abstract:

This chapter discusses information that can be obtained from a single year's documented reports about disputes in the application of Building Regulations. It is argued that data produced by examining documented disputes can be used to gain insight into the nature of the internal structure of regulations.

Characteristics of problems, which arise in applying regulations, are described to explain by example the type of information that can be obtained. The process of analysing reported disputes is described and results summarised to illustrate the elements involved by noting issues that arise.

Having considered the results of the analysis, further outlined examples are given to illustrate the implications for identifying components of internal structure within the Building Regulations.

Finally, the implications of information gathered in this way is considered in terms of justification, effectiveness, purpose, and performance with tabulated observations, gleaned by interviews, about attitudes to regulations.

6.1 INTRODUCTION

Earlier chapters have examined the role of regulations, reviewed the legislative framework, put forward a systems model, and placed the Building Regulations within this context. This chapter suggests that looking at the nature of problems, which arise in the application of regulations, provides clues about the internal structure of regulations.

The chapter begins by describing general aspects of complications in the application of regulations. It was pointed out earlier that Schauer referred to such difficulties in the application of regulations as "recalcitrant experiences". Many of his observations depend on noting the questions that arise when these occur. The process of testing each part of a regulation, on occasion formally, when there is uncertainty about its meaning, may lead to a re-evaluation of boundaries of operation of the various components of the regulation. It can sometimes cause a revision or withdrawal of the regulation. Furthermore, Schauer points out that some degree of generalised entrenchment is necessary for a regulation to have any effect. It is shown in the analysis of recorded disputes about compliance with the Building Regulations that it is mainly at this level of the regulation that disputes arise.

The source of data that is analysed deals with documented disputes and is published by the Institute of Building Control. These reports provide commentaries on the outcome of appeals against decisions of Local Authorities not to relax specific aspects of specific regulations. They also cover submissions to the Secretary of State for determinations on the interpretation of regulations where Local Authority has rejected plans as contravening one or more regulations. Based on analysis of one year's reported disputes and because disputed regulations have received extensive scrutiny, it is shown that we can identify the principal parts of a regulation. We can also find pointers to the underlying causes of disagreement which are explored in the next chapter

6.1.1 Information generated by disputes

The first stage of analysing the disputes was based on the composition referred to in Chapter 4 where it was found that a regulation can be divided into two main parts. The first part is the 'antecedent' or 'situational specification', which deals with the circumstances that trigger the regulation. The second part is the 'consequent', referred to in this dissertation as the 'response definition'. It will be seen that disputes can be generated by either part and that issues can arise out of ambiguities in the relationship between situational specification and response definition.

After looking at examples of the types of difficulties, which occur in relation to regulations, this chapter focuses principally on material generated from disputes. How such difficulties provide insights into the internal structure of regulations are illustrated by reference to the Building Regulations. Disputes described in examples of Appeals and Determinations under the Building Act 1984 are examined to determine the part of the regulation where the main issue in dispute is located. This information is further used to identify the basis of the disagreement and obtain an indication of the underlying cause.

6.2 QUESTIONING THE MEANING OF REGULATIONS

6.2.1 General

Difficulties begin when an individual tries to assess whether an intended solution complies with regulatory stipulations. There may be additional complications when two or more people are involved in applying regulations because their different perspectives may lead to alternative interpretations. There is often disagreement between the letter and the 'spirit' of the written words, or dispute about the meaning of certain words or phrases. These may impact on (i) the description of the situation triggering the regulation, or (ii) the conditions which should apply to comply with the regulation. These complications affect the decision

about the extent to which compliance with the regulation has been achieved.

6.2.2 Inevitability of challenge

It has been suggested by Schauer that a reaction against regulations is inevitable and confirms that they are working - "We thus see rules as essentially frustrating, exercising their influence by getting in the way."[1] It appears therefore that for a regulation to exist it should be challenged from time to time; otherwise it is not having an effect in controlling undesirable outcomes. Therefore some level of dispute is a healthy sign of effectiveness rather than a sign of some deficiency unless the same regulation, or part thereof, raises a number of objections well above average, in which case one may suspect a breakdown of one or more key elements in its use.

Another way of looking at this issue is to consider the question raised by Dworkin[2], in which he asked "How can two people who have the text of a statute in front of them disagree about what it actually means, about what law it has made." The similarity between statutes and regulations has already been discussed and the issues raised will be looked at further in the next chapter. For the time being it is probably worth noting that it is only at the time a regulation is drafted that a small group of people have a common idea of what a regulation is entirely about and of the circumstances which caused it to be created. The process of drafting a regulation is one involving compromise and gradually developing convergence of views. Once that time has passed it is natural for different views to emerge about the way in which the regulation impacts on the target situation. The dynamics of this situation alert us to the risks involved in drawing too many inferences from a small number of disputes dealing with just one regulation.

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[1] [Schauer91, p.87]

[2] [Dworkin86, p.16/7]

6.2.3 Example of legislative dispute not related to the Building Regulations

An example of the kind of problem which can arise within regulations in general is given by Sergot in describing the different interpretations arising out of appeals to do with "Housewives Non-Contributory Invalidity Pension" (HNCIP). In this case, in Northern Ireland it was held that a woman who is capable of performing a substantial amount of her normal household duties is thereby excluded from benefit. In the rest of the UK it was enough to be *incapable* of a substantial amount to receive benefit. The difference turns on the definition of 'substantial'.[3] Sergot later mentions an example of imprecision the "time at which an individual becomes a British citizen by section 1-(1) of the British Nationality Act". He points out that in order to run a computer program to process the clauses of the Act it was necessary to make "some additional assumptions"[4]. This issue also arose within the situational specification section of the legislation.

6.3 DISPUTES IN APPLYING THE BUILDING REGULATIONS

6.3.1 Experience of disputes

The author's personal experience as an architect of 30 years' standing suggests that, in the construction industry, different views about the application of the regulation lead to problems of interpretation, disagreements, or formal disputes on a relatively small number of occasions. It should be noted that under Building Control enforcement the bulk of disagreements are settled without invoking formal procedures of appeal or determination.

Formal disputes generally take one of the following forms:

1 the controlling body believes that a regulation should be *applied*

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[3] [Sergot85, p.14] Here the difficulty is situated in defining the circumstances which determine whether the provisions about entitlement of a pension apply, in other words - the 'situational specification'.

[4] [ibid. p.25]

whereas the affected party disagrees. In this case complications are likely to stem from difficulties in interpreting the *situational specification.*

2 the controlling body and the affected party have different views regarding the *effect* of the regulation. If it is agreed that a regulation does apply in a given situation, disagreement may focus on whether required features are to be present, or whether limits imposed are being complied with. These are aspects of the *response definition.*

At this point it is important to emphasise the various degrees of dispute possible.[5] They range from doubt about the application of a regulation, (usually resolved by negotiation) through to confrontation culminating in an application for a decision from a higher authority. In the case of *The Building Regulations 1985* the higher authority is the Secretary of State.

6.3.2 The parties involved in interpretative issues

Interpretative difficulties and disputes occur in the compliance section of the systems model put forward in Chapter 4. The parties involved are: owner; building designer; builder; and Building Control Department of the Local Authority. The roles may overlap, where for example the builder, or the Local Authority is also the owner of the building. The stance taken by the different parties is related to their role in the overall process of ensuring regulatory compliance.

The owner is usually largely unaware of the complications involved in complying with Building Regulations and only becomes aware of difficulties if serious complications arise. Legal advisors, who ensure that no outstanding matters affect the title to the property, and

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[5] There are a number of side effects of regulations which are more difficult or impossible to quantify; 1-people may be deterred from acting because of the existence of regulations that they are not sure about, 2- cost of compliance may be incorrectly seen as a barrier to action, 3- there is a learning cost to be accounted for, 4- conflict with other regulations may be an inhibitor

which might obstruct future sales, will deal with the owner's obligation. Owner's concerns are concentrated on possible delay and increases in cost.

The building designer is keen to obtain approval quickly to minimise workload and to keep the project to programme. This places power in the hands of the building control officer evaluating the proposals who can exert a great deal of influence on the approval process. It is usually the case that the building designer has less expert knowledge about recent decisions concerning fine points of detail and will therefore be inclined to accept guidance from the officer concerned to resolve disagreements. However, where substantial cost or delay is likely, the designer may object to some of the views put forward and seek further advice from experts on specialised issues.

Building control officers are continually updated regarding the latest interpretations of difficult regulations. The degree of precision within the wording of the regulations gives little room for discretion about which rule to apply. However, they have much more latitude about the appropriate form of construction to be adopted to meet the requirements of the regulation. This is reflected in the results of the analysis of the formal disputes listed in Appendix B. Nevertheless, each officer has a certain amount of discretion that is applied during advisory sessions or in negotiation. Different experiences and training may focus their attention on particular issues whilst tending to make them more lenient on others.

Officers are, of course, endeavouring to apply consistent standards whilst at the same time aware that certain rulings might be costly and not necessarily directly relate to the original intention behind the regulation in certain circumstances. Furthermore, they are also subject to workload considerations and are keen to avoid protracted negotiations. The Building Control department will probably wish to avoid a large number of appeals against its decisions since this could be interpreted as obstructive.

Each of the parties involved has a different agenda whilst at the same time seeking to

comply with the requirements of the Building Regulations.

6.3.3 The main layers of interpretative difficulties

The first occasion when difficulties in interpretation are likely to arise is when a design solution, which may be affected by control, is being considered. The designer will know the answer to most of the questions from experience. This represents the lowest level portrayed in Figure 6.1 below. However, in unusual construction, situations arise where there is some doubt regarding the precise implications of the relevant regulation, or even whether a particular regulation has a bearing on the arrangement proposed.

In many cases, proposals are then discussed with a Building Control Official. This is the second level shown. Such discussions are not usually documented because they are minor matters sorted out in discussion with the controlling body without leading to any sort of formal action.

The design team, architect, building designer, or builder then submits proposals to the Local Authority's Building Control department. These are intended to comply with the requirements of the Building Regulations. At this point, if not accepted by the Building Control department a number of matters may need to be settled by negotiation. On a large project such as a shopping centre, where unconventional construction may be involved and special fire provision required, the time taken to achieve an approval can represent a substantial part of the working drawing period.

The third level of complication arises when further and more detailed information is required from the design team. Experience shows that this happens with most applications relating to the larger construction projects. It is not always clear how much extra information is needed or whether the applicant has correctly understood the point of the request. Usually these questions are resolved by revising the proposals or by further explanation and trade-offs in the typical fashion of compromise between dissenting parties.

These discussions may eventually lead to a request for a relaxation to be granted by the Building Control department on a specific aspect of one or more of the regulations.

At this stage the parties concerned do not usually include the building owner who will only become involved if questions arise of cost or delay. Nor will the Secretary of State take part in this level of negotiation having delegated the procedure to the Building Control department of the Local Authority.

It is important to recognise that the bulk of the interpretative difficulties, relatively minor recalcitrant experiences, occur at these three lowest levels. Most are sorted out by the building designer after further investigation or by discussion as indicated above.

Once approval has been given, work can start on site, but further complications may arise during inspections by Building Control Officers who can require changes to construction as work proceeds. Needless to say, if much expense is involved there may be extensive discussions before work on the disputed area can continue.

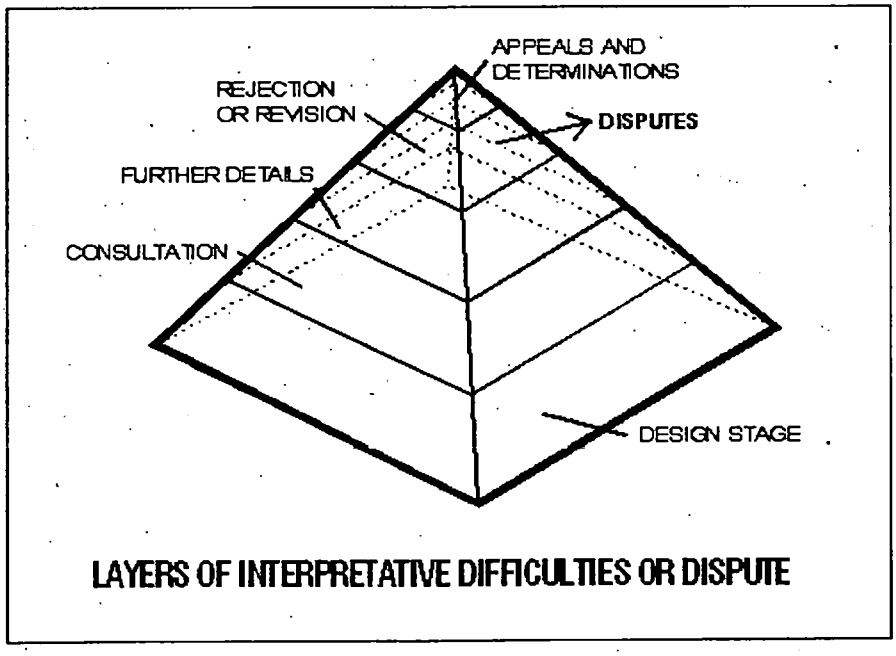

FIGURE 6.1

6.3.4 The progression of interpretative difficulties

When the designer is considering whether, for example, an adequate means of escape has been provided for a proposed loft conversion, he will initially rely on his experience of similar situations. His first thought will probably be to confirm whether any special provision is needed and he may conclude that it is not. Alternatively, he may feel unsure about the precise requirements, and consult the regulations. If doubt remains he may decide to consult a colleague or even request a meeting with the Building Control department. This evaluation process is represented by the lowest layer of Figure 6.1 above and accounts for the much larger proportion of investigations into meeting the requirements of the Building Regulations.

Once a completed set of working drawings is available and the designer is confident that they comply with the Building Regulations they will be submitted for approval. In the example mentioned, the building control officer may decide that a means of escape is required where it is not shown in the proposals. Revisions may be requested and in most cases the matter is resolved by agreement. Revised drawings are submitted and approval obtained. Sometimes this process can involve several exchanges of drawings or explanatory calculations and compromises may be required on both sides before resolution.

It is anticipated in this dissertation that the availability of an expanded breakdown of the regulation that makes the generalizations and entrenchments more accessible will help to remove some of the doubt. This benefit should apply to all levels of the interpretative 'pyramid'.

6.3.5 Difficulties leading to a formal dispute

Occasionally there may be a point on which the parties cannot reach agreement. The Local Authority may reject the request for a relaxation or a rejection notice may be issued. Actual disputes may be said to occur at this point, which is the fourth level in Figure 6.1.

If request for a relaxation is not approved, the applicant can submit an Appeal to the Secretary of State for a decision on the point at issue. On the other hand, if the plans are rejected the applicant can apply to the Secretary of State for a Determination against the ruling of the Local Authority. The top of the pyramid in the illustration represents this level and the documented outcomes of such applications to the Secretary of State are the source of data reviewed by this chapter.[6] In the case of the construction industry, disagreement can range from the relatively trivial to lengthy processes taking months to resolve.

According to the DOE there were around 90 Appeals or requests for Determinations during 1992/3, a figure that is reducing annually because of increased powers granted to local officers for interpretation[7].

6.3.5 Typical examples of Building Regulations disputes

An indication of the kind of issues that arise is given by two examples taken from the journal of the Institute of Building Control.

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[6] [Appeals/Determinations89]

[7] [Bovill93]

[8] [Schauer91, p.87]

[9] [Dworkin86, p.16/7]

[10] [Sergot85, p.14] Here the difficulty is situated in defining the circumstances which determine whether the provisions about entitlement of a pension apply, in other words - the 'situational specification'.

[11] [ibid, p.25]

[12] [Bovill93]

6.3.5.1 meaning of the word 'over'

Section 18 of the Building Act 1984 dealt with the subject of building over sewers.[13] Several queries have been raised concerning the precise definition of the word 'over'. Certain Water Authorities taking the view that 'over' is not necessarily synonymous with 'above' or 'immediately above' provoked much of the discussion. They argued it means 'close to' or 'adjacent' which in some cases lead to suggestions that buildings should not be erected closer than 3 metres to the public sewer. After lengthy discussion the Technical Committee of the Building Control Institute advised members that 'Building over a sewer' does not include a sewer which is outside the external walls of a building. In this case one of the controlling bodies was attempting to modify the scope of the regulation (a component of the situational specification) to make it easier to have access to drains near buildings. In effect this was an attempt to extend the meaning of "over" to suit practical problems of maintenance. It is an example of a difference between the letter and spirit of a regulation affecting the conditions that would cause the regulation to be triggered in the first place.

6.3.5.2 small public conveniences - threat to health or safety?

In the same document[14], there is a report of a question raised about the installation of controlled services in an exempted building. The conclusions reached were that, due to the wording of the clauses, a small block of public conveniences (less than 30 sq. m and more than 1m from its site boundaries) could be erected without control of either sanitary appliances or heat producing equipment. The writer of the article concluded that such an exemption could pose a definite threat the health and safety of the public.

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13 [Building Control November/December 1985 p.5-11]

14 [ibid p.11]

In this case, the definition of permitted areas for exemption overlapped, producing an unexpected result. The outcome arose by strictly applying different definitions of exempt works from two separate parts of the building regulations, and relates to the specification of conditions that invoked the regulation.

These examples illustrate how regulations can be troublesome when applied to particular situations. They draw attention to the significance of the situational specification as one of the main components in a regulation. They also suggest that parties in dispute may attempt to rely on the purpose behind a regulation as a means of justifying their position.

6.4 ANALYSIS OF DISPUTES

6.4.1 Department of the Environment - Appeals and Determinations

The Building Regulations 1985 includes procedures to deal with most of the situations which arise when there are disagreements about their specific application. The Institute of Building Control publishes annually a review of "Selected Appeals and Determinations by the Department of the Environment" (see Appendix B: Analysis of Appeals and Determinations).

6.4.2 What documented disputes can tell us

To show the kind of questions which can be addressed the first page of the appendix gives a statistical breakdown of the results in terms of: applicant's success; location of dispute; underlying cause; and disputed regulation. On first examination these data can identify the

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[15] There are a number of side effects of regulations which are more difficult or impossible to quantify, 1-people may be deterred from acting because of the existence of regulations that they are not sure about, 2- cost of compliance may be incorrectly seen as a barrier to action, 3- there is a learning cost to be accounted for, 4- conflict with other regulations may be an inhibitor

various kinds of issues that may lead to a dispute. Secondly we can examine the reasons given for the decision and compare this with the arguments put forward by the protagonists. Furthermore, the results of analysis point to the source of disagreement in the regulation and in which segments it. Issues created by external factors or related to problems of internal construction are highlighted.

Comparing the parts of a regulation with the kinds of difficulties that they can produce enables us to increase our understanding of how they perform together and how changing circumstances alter their effectiveness. Questions about the nature of internal structure are partly answered by finding the boundaries between the various parts of a disputed regulation, and shown up by the analysis.

Documented disputes also provide an accessible basis for comparative assessment. They show significant variation in the number of disagreements for each regulation that have gone as far as the Secretary of State. Quantitative comparison between numbers of appeals/determinations relating to specific regulations, clauses, or components of regulations tells us more about uneven performance. This may in turn imply reduced effectiveness in dealing with the concerns that were raised by the original justifications for the regulation.

6.4.3 Most frequent dispute

One dispute which occurs far more frequently than most (42% - 61 out of 146 in the review dated 1989) deals with the topic of "means of escape in the case of fire" - Regulation B1. What is it about this particular regulation which causes so much dispute?

6.4.3.1 Clause B1 states:

> (1) There shall be means of escape in the case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.
>
> (2) This requirement may be met only by complying with the relevant requirements

of the publication entitled "The Building Regulations 1985 - Mandatory means of escape in the case of fire" published by HMSO (1985 edition).

The regulation is further qualified by a section dealing with "Limits of application" which states:

1 This requirement applies only to -

(a) a building which is erected and which -

(i) is or contains a dwelling-house and is of three or more storeys,
(ii) contains a flat and is of three or more storeys,
(iii) is or contains an office, or
(iv) is or contains a shop;

(b) a dwelling-house which is extended or materially altered and will have three or more storeys, and

(c) a building of three or more storeys, the use of which is materially changed to use as a dwelling-house.

2. The means of escape provided need only, in the case of a dwelling-house or a building containing a flat, afford escape for people from the third storey and above and, in the case of a building containing an office or a shop, afford escape for people from the office or shop.

There are extensive explanatory notes, much longer than in the case of other similar regulations, explaining that this regulation differs because it is mandatory and giving reasons why it is so specific. The notes refer further to related legislation[16] dealing with particular risks associated with different building types.

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[16] [FPA71], [FCR76], [HA80], and [HO81]

6.4.4 Results of Appeals

Out of 36 Appeals reported[17], against refusal by the Local Authority to grant a relaxation, 17 were allowed and 19 dismissed. Some of the more interesting decisions are tabulated below:

Ref	matter disputed	reason for dismissal	reason given for being permitted
3	cill to eaves distance over 1.5m, cill height over 0.9m	too far over limits - could be lowered	
4	fire-resisting doors not provided at ground floor	alternatives considered to be available	
7	means of escape proposed over flat roof less than 1/2 hr fire resistance		considered that an acceptable alternative to the requirements was being provided
13	route from second floor not fully protected	no reason why acceptable protection should not be provided	
17	Spiral space-saver stair provided as access to room in loft	not acceptable alternative to straight stair as means of escape	
18	Council required double door protection at first floor level		satisfactory means of escape provided
21	relaxation requested for omission of lobbies to two flats		granted
22	unventilated lobbies required to separate upper flat entrances from staircase		1/2 hour fire-resisting doors considered sufficient protection
27	Whether a gallery with restricted headroom should be regarded as a habitable room	Space could possibly be used for sleeping and needing escape route	
34	Geometry of escape stairs in an office block		Revised standard not yet in effect – case related to current requirements.

[17] [Appeals/Determinations89]

6.4.5 Relationship to building usage

The 36 cases referred to above are broken down as follows:

Loft conversion	15
roof conversion	1
room in roof	1
conversion to flats	6
flats	2
three storey house	2
alteration from 4 to 5 storey	1
additional storey	1
Cold store	1
offices	3
alterations to shop premises	1
retail unit	1
warehouse	1

The preponderance of cases relating to loft conversion is partly a consequence of the much larger number of alterations to domestic properties as against other building types. The property market may also influence the frequency of such applications by creating circumstances in which it is more economical to carry out loft conversions rather than move house.

Despite such extraneous factors it is still illuminating to examine the kinds of things which are challenged. The situational specification is that the regulation relates to dwellings, offices and shops, with the intention of protecting the safety of the occupants of the buildings. In the reported cases there are disagreements about the scope of the regulation. The response definition is in three parts. No disputes were found in respect of two of these: the purpose and the controlled entity - which in this regulation is 'means of escape'. The constraint which requires that 'means of escape' be provided in such a form that it can be used safely and effectively at all material times is the main area of contention for this regulation.

6.4.6 Further comments on the analysis

Nearly 60% of the submissions were successful over the period in question. Although this information does not relate directly to questions about internal structure, it shows that despite their specialised knowledge, the Building Control departments were upheld in the minority of disputes. This reveals the degree of difficulty in predicting the outcome of disagreements where the issues being interpreted are on the borderline.

The division into the two main segments of the regulation shows that 75% were caused by the response definition as would be expected from everyday experience. Persons within the construction industry would expect most disputes to be about meeting the requirements of the regulation. It is of special interest therefore that where the Secretary of State found against the Local Authority a much higher proportion, 40%, of the cases, concerned whether or not the regulation applied. This finding emphasises the role of the situational specification in triggering the application of the regulation. In passing, it also suggests that in some cases Local Authorities may try to insist on conforming to a regulation not warranted by the circumstances of the proposal, to err on the safe side.

Where views of the Local Authority were upheld, the working of the regulation was found adequate by the Secretary of State, implying sufficient clarity of expression to deal with the circumstances of the dispute.

Considering the areas giving rise to the dispute, we can see that the bulk of the disputes arose out of uncertain descriptions in the specification of either the situational specification or the response definition. These gaps will be examined more fully in the next chapter. A significant percentage involved related standards that are invoked by the regulation or its Approved Documents.

Interpretation of meaning was also a factor in nearly 10% of the cases, showing that a significant number of successful challenges were made to the meaning of words or phrases.

By far the largest group - 42% - concerned disputes about conforming to regulation B1 dealing with "means of escape in the case of fire" and the second largest also related to fire but in terms of treatment of the fabric of the building.

6.4.7 Implications

The above examples suggest that where a clear constraint limit is set, appeals tend to be disallowed, except for one or two exceptions which are listed in the document quoted.[19] The exceptions were considered acceptable by the Secretary of State because of alternatives proposed. The interesting thing is that so many appeals *were* made against such clear boundary conditions, particularly when the evidence shows that the chances of successfully appealing against specific guidelines are not great. However, where the requirements are a more complex mix of interacting obligations, the appeals tend to be successful even though in many cases express stipulations on one or two points have not been met.

Inspection of the results about the B1 regulation shows that 12 (22%) were in the situational specification and 42 (78%) in the response definition. Further examination shows that the bulk of the disputes that with the situational specification were where the applicant was successful. Given the small number of samples, no claim is made that these results would generalise to the whole population of disputes. However, a less rigorous analysis of a succeeding year's disputes gave similar results.

Chapter 9 considers the application of a frame-based approach to representation of regulations to make use of information obtained by noting where the impact of the dispute was situated within the disputed regulation.

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18 [ibid.]

19 [Appeals/Determinations89, nos. 35 and 54]

6.5 POINTERS TO INTERNAL STRUCTURE

6.5.1 Introduction

It has already been suggested that the two main parts of a regulation, the situational specification and the response definition, enable us to categorise disputes into two main groups. This section of the chapter considers examples of disputes under *The Building Regulations* that give clues about internal structure.

6.5.2 Disputes about the situational specification:

Domain, sub-domain, and topic are the components making up the situational specification. *Domain* describes the most general classification of the type of building to which the regulation applies. *Sub-domain* is a sub-classification, and *topic* further refines designation of the specific area. These terms will be described more comprehensively in later chapters, but are used in the examples below to show how individual cases can point to specific components.

6.5.2.1 domain - belief that regulation did not apply

An example of a dispute in which the relevance of the domain was challenged is a case[20] dealing with an adaptation to a house, which was to be converted into a rest home for old persons. Under regulation 5 of the Building Regulations it is necessary to give notice if a material change of use of a building is proposed (from one domain to another). The applicant took the view that this regulation did not apply because there was no change of use because old age is, in itself, not an infirmity. This case turned on deciding which of the domain categories given in the situational specification of the regulation best described the function of building.

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20 [Building Control issue15, p.38]

6.5.2.2 sub-domain - not clear that regulation applied

Cases where it is not obvious that a regulation applies may touch on either the domain or sub-domain component within the situational specification. An example[21] is a dispute raised about the scope of regulation E2 - Airborne sound (floors) where it was determined that a building for elderly people is within the classification of 'other residential' being a 'home' and therefore not 'institutional'. The effect of this decision was to make the requirement of this clause less onerous. Such cases draw attention to the sub-domain section of the situational specification.

6.5.2.3 topic

No examples were found in the Appeals and Determinations examined. This is presumably because there are few cases where the topic itself is disputed.

6.5.3 Disputes involving the response definition:

These are examples of differing views regarding the requirements of the regulation when it has been acknowledged that the regulation does apply.

6.5.3.1 purpose of regulation

The Council opposed a proposal for the erection of a cover to a swimming pool[22] because, in their view, it did not meet the specification for a structure that would safely transmit loads to the ground[23]. The Secretary of State accepted that deflection was higher than for conventional buildings but considered this to affect long term serviceability rather than health and safety and therefore determined that the proposal was in conformity with the

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21 [Building Control issue13, p.31]

22 Reference to 'Council' acknowledges that representations by a Building Control Department are made on behalf of the Council of which it is a part.

23 [Appeals/Determinations89, no.45]

requirement A1 of Schedule 1 to *The Building Regulation 1985.* His decision took account of his view of the regulation's purpose.

6.5.3.2 definition of the required feature of a controlled entity

In a further case[24] the requirement for enclosure of means of escape at ground floor level was challenged by reference to an alternative stipulation which can be followed in substitution for the more stringent requirements in BS5588. The Council quoted certain parts which, in their view, although not specifically mentioned, implied that protection of the means of escape should exist. This is a clear reference to both the entity being controlled and to a feature that, it was alleged, should be provided. The determination found that no specific requirement was contained in the regulation and therefore the proposed construction was in conformity with the regulation.

6.5.3.3 constraint - narrow definition not upheld

In a case[25] dealing with means of escape in the case of fire the controlling authority took the view that a window from a loft conversion had to be in the slope of the roof in order to comply. Both parties agreed that the regulation applied but disagreed regarding its requirements for the building alterations taking place. The Secretary of State held that a gable end position was acceptable. Clearly the response definition of the regulation was not stated clearly enough to prevent more interpretations being put forward than originally intended.

6.5.3.4 constraint - modification to imposed limits

The Council carried out the calculation of the required maximum travel distance on the

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[24] [ibid. no.56]

[25] [ibid. no.54]

basis that means of escape should be considered as a whole, and not section by section[26]. The applicant, however, proposed a pressurised lobby to take account of pressurisation as a way of keeping corridor routes smoke free and as recommended by the code of practice called up by the mandatory rules. The applicant argued that the length of the escape routes to the lobby complied with the regulation and this view was accepted by the Secretary of State. The detailed limits contained in the constraint section were scrutinised by this determination which emphasises their distinct role. In this case, the stipulation was that the given distance should not be exceeded, although the dispute was about the positions from which to take measurements.

The above cases make it clear that distinct sections within the two main parts of each regulation carry out different functions. A more extensive study of the implications of this will be given after the description of the computer model which was used to test the reports of Appeals and Determinations to derive comparative information about the performance of the regulations concerned.

6.5.4 Justification and Purpose in Regulations

Justification and purpose are two aspects of the reason for the existence of a regulation. A clear understanding of their role is important when assessing the impact of recalcitrant experiences in applying a regulation. As we can infer from the systems model, this is because the justification is derived from the concerns that caused the regulation to be created in the first place. The purpose is the aim behind the conditions required to reduce perceived risks. Where an appeal is allowed, or a determination finds against the Local Authority, it is implicit in many of the judgements by the Secretary of State that he has referred back to his perception of the regulation's purpose. This is often done in the context

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[26] [ibid. no.70]

of the more general considerations indicated by the continuing justification for the regulation. The purpose of a regulation determines the starting point for questions about interpretation.

6.5.5 Justification

Problems associated with the use of buildings result in generalisations which lead to over- or under-inclusiveness with a resulting possibility that the mapping of the original justification on to the target area will be imperfect. The effect of this is that the designers of a regulation have to assess the probability of a regulation being ignored, or being applied to situations for which it was not intended. This leads directly to questions about the way in which constraint boundaries are fixed and how the settings chosen for the constraint mechanism were selected. Furthermore, because regulations restrict behaviour, they are liable to regular scrutiny when, for example, it can be argued that the circumstances on which the original justification was based have changed.

We saw from the systems model that the background justification,[30] the pressure for a regulation, arises out of public awareness and a political sense of public duty. This is the

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27 The construction of eccentric foundations on the boundary of properties is such an example. The theoretical solution is often impossible to achieve and if insisted upon would prevent work proceeding. A compromise has grown up, relying on empirical knowledge, which is acceptable to most Building Control departments.

28 Twining and Miers devote four out of ten chapters of their book to aspects of interpretation, and cite an article by Dworkin to support the suggestion that a 'theory of legislation' is needed to guide judges and others in how to approach the task of interpretation [Twining/Miers91 p.374].

29 In writing about "Intentions, reasons and purposes" Twining and Miers comment "This brings us to the important topic of the role of intentions, aims, purposes and other reasons in the interpretation of rules. A good deal of confusion attends these notions both in the literature and in practice...."

30 Schauer's view of purpose relating to the general operation of rules is described in section 2.2.6, and in relation to the wider issue of law in society in section 2.4.2.

connection between the actual regulation and the wider environment. The "justification" writes Schauer " thus determines which among logically equivalent generalisations from some particular event will be selected as the factual predicate of the ensuing rule".[31] He pays particular attention to the function of the justification but when discussing questions about interpretation tends to use 'purpose' as a synonym. In this thesis specific meanings are attached to justification to reflect its position in the system model. It is taken to describe the generalised view of why a regulation is made. 'Purpose' on the other hand is used in the sense of the particular aim identified for an individual regulation. Used in this way 'purpose' is more local in its meaning than 'justification' - the justification for a 'No Smoking' rule is connected with health whereas the purpose is simply to stop persons from smoking.

The distinction has a bearing on assessment of a regulation's effectiveness. The 'effectiveness' of a regulation can be regarded as the extent to which it is successful in dealing with the general concerns of public or political systems. The distinction between justification and purpose provides a background against which success, deficiency or failure may be assessed.[32] Thus failure of a regulation to contribute positively to support its justification is a sign of reduced effectiveness which is likely, over time, to result in generalised pressures for reform through the political process. However, effectiveness is a difficult phenomenon to measure because the initial reasons behind the original justification may become difficult to determine after a long period.

Mention has already been made of Schauer's view that one of the necessary side effects of

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[31] [Schauer91, p26]

[32] In the case of Building Regulations pressure for a new regulation usually comes from a disaster, as in the case of Ronan Point, and is reactive, whereas the pressure for a commercially lead regulation is pro-active in that it is trying to create a situation favourable to increasing product sales.

rules is that they never achieve complete success in fulfilling the original justification behind them.[33] His argument is based on the logical outcome of generalisations that are embedded in rule structure. He points out that drafters of regulations often allow for this effect by widening or narrowing the domain of their application. Those evaluating information derived from disputes must be aware of the possibility of such distortions of the original justification.

6.5.6 Purpose

The issue of 'purpose' is frequently a starting point for interpretative guidance when difficulties are encountered. It has already been suggested that it is not always easy to determine the aim of a regulation. A further complication is that not only is it difficult to be sure about the purpose; but also that changing circumstances may make determination of the original aim liable to more than one interpretation. However, in the case of *The Building Regulations* there is an overall justification declared in the notes which accompany the Statutory Instrument.[34] The purpose of each regulation is then inferred from the section heading. If there is a dispute, one question is whether the purpose is affected. The answer may point to a lack of definition in either the situational specification or in the response definition. In the most extreme case the regulation may be found to be completely unable to prevent the risks being regulated against and, in consequence, to be failing to carry out its function.

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33 "The emerging picture depicts rules as necessarily sub-optimal. Rules may sometimes or frequently be good things to have, but a system committed to rule-based decision making attains the benefits brought by rules only by relinquishing its aspirations for ideal decision making." ....."Although there will be occasions on which the rule-indicated result will be inferior to the justification-indicated result, there will be *no* occasions on which the rule-indicated result will be superior to the justification-indicated result."[Schauer91, p.100]

34 This refers to the main aim of safeguarding the health and safety of persons in and around buildings. A supplementary objective is the preservation of fuel and power. A narrower focus is explicitly stated, or implied, by each of the section headings within the regulations .

In the case of the purpose of a regulation, our interest is in the relationship between the conditions to be achieved and the extent to which this has been, or is being, done. For example, whether the "No Smoking" rule actually prevents any occurrences of smoking in the prescribed area. The case quoted in section 6.3.4.2, dealing with the meaning of the word "over", shows how a regulation came to be modified to ensure a particular result. The Water Authorities were concerned that from their standpoint the various meanings of "over" could allow drains to be constructed where access would be difficult or even impossible. The purpose, or objective of a regulation, is frequently called upon as a guide to interpretation because it should describe the situation the regulation was designed to produce.

6.5.7 'Justification' and 'Purpose' assist interpretation

The role of both 'justification' and 'purpose' influence interpretation of data obtained from disputes. It is worth considering whether knowledge of internal structure might improve the performance of a regulation and help in assessing its effectiveness in relation to the concerns that created it. The intention behind a regulation may become obscured when there are so many disagreements about interpretation that both sides tacitly agree to bypass its contentious aspects. In such situations it may become accepted that a form of construction is deemed acceptable to both sides because it avoids complications in obtaining approval.[35] As can be seen from the results of the analysis of disputes, regulation calling for adequate means of escape in the case of fire, may be considered to be imposing restrictions which are clearly too onerous in an unusual situation. Compensating factors may be present but are not taken into account by the regulation. Such considerations

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[35] The construction of eccentric foundations on the boundary of properties is such an example. The theoretical solution is often impossible to achieve and if insisted upon would prevent work proceeding. A compromise has grown up, relying on empirical knowledge, which is acceptable to most Building Control departments.

change the context of what may at first sight seem to be evidence of structural flaws in the construction of a regulation. These situations can happen without necessarily reducing the overall effectiveness of a regulation.

Interpretation is an important aspect of the applications of regulations.[36] Twining and Miers mention three themes. Firstly, the generality of problems of interpretation extending into non-legal contexts, "that what constitutes an appropriate interpretation is relative to the situation, role and objectives of the particular interpreter". Secondly, the importance of context of the situation. Thirdly, how the problem was created. They recommend a series of procedural steps to clarify the various arguments that arise and to deal with single words or phrases in a methodical and traceable manner. The concept of "hard" and "easy" cases in relation to interpretation was referred to in section 3.2.2., because this issue goes to the heart of deciding whether a regulation will be straightforward to interpret in a particular case.

Despite the controversial nature of the interpretative process[37] it is evident that justification and purpose play a substantial role in arriving at decisions about the intention of the regulation. It seems reasonable therefore, that any complete representation of a regulation should make these objectives as clear as possible.

6.5.8 Effectiveness

Discussions about difficulties caused by regulations include the question of how effective

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[36] Twining and Miers devote four out of ten chapters of their book to aspects of interpretation, and cite an article by Dworkin to support the suggestion that a 'theory of legislation' is needed to guide judges and others in how to approach the task of interpretation [Twining/Miers91 p.374].

[37] In writing about "Intentions, reasons and purposes" Twining and Miers comment "This brings us to the important topic of the role of intentions, aims, purposes and other reasons in the interpretation of rules. A good deal of confusion attends these notions both in the literature and in practice...."

they are at doing the job for which they were created. Whereas disputes in the application of a regulation are proof that it is having an effect, it is a matter of judgement as to whether the number of disputes is excessive. This is a difficult question to answer because there are a lot of minor instances of complications in applying regulations that go unreported because they are resolved by negotiation or worked around.[38]

Often minor complications cause some delay but are not serious enough to merit formal disputes. In the case of building control, excessive queries about a particular regulation will attract attention and the regulation will eventually be either withdrawn or amended. The example given in section 6.3.5.2., regarding classification of exempted buildings, raised doubt about the intended outcome of the regulation because of uncertainty about the extent of control intended. Where more intransigent problems cannot be resolved by local negotiation, they have been documented as part of the appeal process, and both sides of the argument explained.

In the systems model, obstacles to straightforward application of *The Building Regulations* are situated within the compliance sub-system. If it is judged that the number of disputes is excessive, an alternative form of the regulation may be needed to maintain its effectiveness without causing so much doubt about its application.

A second issue is whether the overall objectives are being achieved. Questions about effectiveness relate the original justification to its wider social context - the issue of whether public concerns are being adequately addressed. To discuss the justification for regulations in terms of the wider needs of society raises many controversial issues about which there is no clear consensus. For example, when asked how much do building regulations

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[38] It has been argued by Schauer that there is some loss of effectiveness when the original justification is transferred across into the actual instance of the regulation.

contribute to the control of the construction industry, a senior Building Control Officer[39] stated that they give no effective control at all. He drew attention in particular to the presence of manufacturers' pressure groups who lobby for regulations to be instituted to increase the market for their products or services. Although this is perhaps a cynical view, it is of importance because of the length of experience of Building Control procedures by this senior official and because of his standing within the building control profession.

The Building Regulations Advisory Committee, in its first report to Parliament in 1964 stated that "the objective of any form of building control is a finished building which conforms to the rules"[40]. The Committee's approach concentrated on the mechanism of control to ensure that rules are complied with, and seemed less concerned about why the rules were there in the first place. This was written over 30 years ago and no longer reflects the declared aim regarding the purpose of building legislation.

Linking the types of problems with their effects we arrive at a matrix which shows how effectiveness can vary:

type of problem	Regulatory purpose	effect
Direct failure	Not achieved	Intended effect of regulation not achieved
Excessive number of disputes	Efficiency damaged	Time wasted
Interpretation problems	Not achieved in some cases	Time wasted
Varying standards	Not achieved in some cases	Performance of regulation reduced

39 Dawson Lillywhite, former head of Building Control for Northampton Borough - interview with author Council

40 [Wright83]

Regulatory performance can also be measured against pre-determined parameters. The DOE have started relating risks in buildings to statistics for accident and fatalities. They see a connection between the overall aim of the Building Regulations and obtaining some reduction in injuries and are trying to develop ways of measuring success in terms of the performance of specific regulations. Because this dissertation is concerned with detail about the relationship between an actual regulation and its original purpose, performance is taken as the term most appropriate for determining degrees of success or failure

In looking at the information available from disputes we need to consider whether the dispute is a fairly isolated case or part of a pattern stemming from a general problem with the regulation. The answer may indicate if there is something wrong in the construction of the regulation or whether it is an example of acceptable resistance to the force of the regulation.

6.6 IMPLICATIONS OF DISPUTES

6.6.1 Attitudes toward difficulties in the application of regulations

A number of interviews were carried out with specialists involved in the application of regulations to find out how problems with their use are perceived. The survey showed a wide diversity of response.

6.6.1.1 results of interviews

INTERVIEWEE	OBSERVATIONS
Dawson Lillywhite Chief Building Surveyor Northampton Borough Council.	Did not consider that the Building Regulations gave much control of standards. Commercial lobbies were main stimulus for regulation in order to get competitive advantage for their products. Main problems seen as administrative because of limited resources
Dr Richard Susskind Masons Solicitors.	Expressed the view that regulations can only be fully understood in the context of case law relating to the enabling Act. Focused on the distinction between hard and easy cases.
Les Levidow Open University.	Mainly concerned with the potential for issuing regulations as a means of encouraging innovation. Saw problems in terms of risk management and setting appropriate standards
Keith Hawkin Centre for Socio-Legal Studies. Oxford.	Problems depend on issues relating to the original purpose and tend to be industry specific. In manufacturing industries constraints tend to be determined by discretion. Considered 'capture theory' linked to problems in assessing effectiveness of regulations.
Prof. Robert Baldwin LSE.	Suggested that problems arise where there is poor anticipation of enforcement strategies. Raised the matter of the "accessibility" of regulations

6.6.2 Consequences of cost and delay

Ultimately the effect of dealing with disputes is to increase the cost to those responsible for the erection of buildings. In a small number of cases the discussion leads to revision of the regulation involved.

However there is also a significant degree of variation in the standards enforced. With so many pitfalls associated with questions of interpretation it is not surprising that there is a risk of standards varying from one control source to another. The new format of *The Building Regulations 1985* which places less emphasis on the content of the Act itself and more to the Approved Documents has also widened the range of solutions which are deemed to comply with their requirements.

Part of the cost created by disputes is caused by the inevitable delays that come about during negotiations and re-submission of revised plans and supporting documentation. Where the issues are taken to determination or subsequent appeal the total delay to the construction program can run into many months. During periods of high inflation this can add significantly to the total cost of building.

In some cases the situation the regulation has been designed to prevent still happens. An example[41] is that of a fire in a detached dwelling where the high temperature of flue gases impinging on timber joists led to a fire because the range of permitted materials was not sufficiently restricted. These occurrences are likely to be connected with boundaries having been poorly defined either in the situational specification or the response definition.

6.6.3 Conclusions

Analysis of disputes is unlikely to be sufficient to reveal all the elements of a regulation

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41 [Building Control, issue 15 p34]

because of the role of generalisation and the connection to related standards. Some of the components necessary to differentiate the regulation or the actual effects of control may not have been the subject of dispute but are necessary to the operation of the regulation.

Nevertheless, comparison of documented appeals and determinations arising out of disagreements in the application of regulations suggests pointers to particular parts of the regulations in dispute. It will be shown in the next chapter that examination of the causes underlying disputes can produce a further layer of detail about internal structure. It will be shown that they fall under the following main headings used in the analysis of the disputes; language, legal environment, incomplete template, and new circumstances.

CHAPTER 7 CAUSES OF DIFFICULTIES WITH REGULATIONS

Abstract

This chapter takes a more detailed look at the results of analysis of the Appeals and Determinations in Appendix B. It considers the causes that form the basis of the disputes previously described, and adds an extra level of detail. It is found that this gives a more secure basis for interpreting information from analysis of building regulations. A better understanding of the underlying structure is achieved providing a more comprehensive framework for putting together an alternative representation of regulations.

The investigation shows that, in the target sample, the main causes of problems are those stemming from gaps in the definition of (i) the conditions to be observed in ensuring compliance or (ii), the specification of the situation, which triggers the regulation. In addition other causes arise from: legal environment; determining meaning; or changes in the conditions that originally gave rise to the need for a regulation.

The effect of generalisations, entrenchment, and over/under-inclusiveness frequently explains the reason for the disputes. Results of the investigation suggest that recognising the influence of these phenomena can illuminate questions about the internal structure of regulations.

This enables us to represent the position in disputed regulations, of obstacles to straightforward interpretation, and be clearer about the form of the internal structure being sought.

7.1 INTRODUCTION

We have seen that difficulties arise in complying with regulations when doubts are raised about exactly how the regulations are to be applied. The effects of such complications are various levels of dispute, which sometimes require a substantial amount of time to resolve. In order to make the best use of the information gained from disputes we need to discriminate between the *causes* of problems and the *effects* that may follow from these problems. This chapter examines the roots of problems that arise when regulations encounter resistance, a process which provides additional information about the internal structure within a regulation. When the application of a regulation is formally tested in a real-life situation, extra material becomes available for investigating internal structure is generated by the discussion and opinions expressed.

Chapter 3 showed that there is a general consensus about the division of a regulation into two parts corresponding to the "IF...THEN" perception of rule structure.

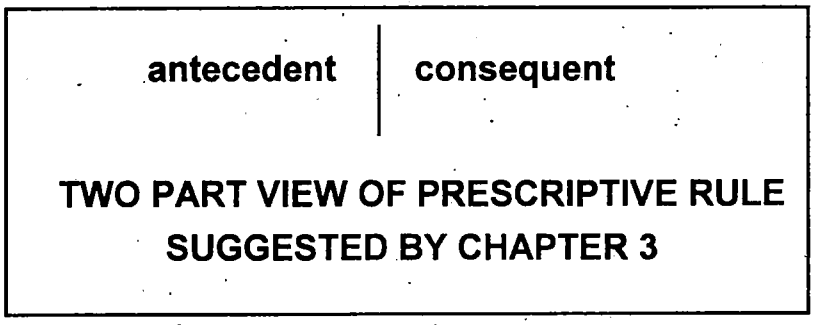

FIGURE 7.1

This chapter picks up threads of earlier arguments regarding the open texture of legal statements from chapter 3, and the environment that produces regulations from chapter 4. It continues on from the conclusions of the last chapter, concentrating on the quoted reports of DOE Appeals and Determinations. In the examples studied, the most frequent *reason* for problems was gaps in the underlying structure of the regulation, and which were *located* how the response definition had been defined.

The previous chapter presented the argument that information from documented disputes could be used to give us more insight into those elements that combine to make a regulation. This extra detail enabled us to put forward a theory about the components of the two parts of a regulation, and to find, from arguments presented in section 6.5 that a third aspect of regulations should be represented. The additional element, 'context', plays an essential role in interpretation.

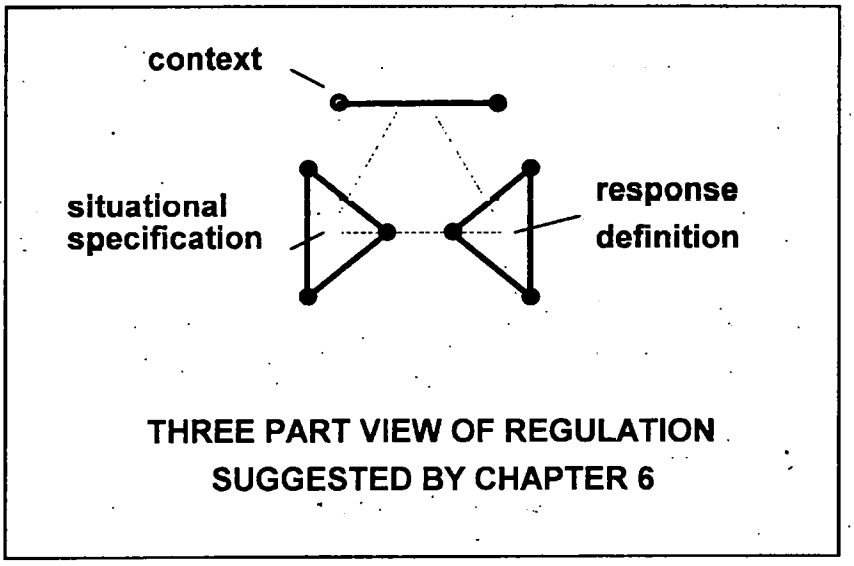

FIGURE 7.2

This chapter attempts to relate the causes of difficulties with regulations to the elements of internal structure from which they are constructed. Documented disputes have been analysed into four categories with different causes. It is now argued that considering the nature of these causes will help us find out more about the elements which need to be represented in the internal structure of regulations.

7.1.1 information generated by disputes

The relationship between a regulation's purpose and problems which arise during its application was explored in the previous chapter, using the systems view of regulations

developed in Chapter 3. Most of the cases covered by the reports of Appeals and Determinations (Appendix B) dealt with disputes caused by lack of clarity in definition, or insufficient precision in drawing boundaries around target areas of interest. The cases reported, which were very specific in nature, are described in this chapter as part of a search for more information about elements of underlying structure that make up individual regulations within *The Building Regulations 1985*. Details obtained in this way give us useful reference points for experimenting with alternative methods of representation. In passing it is worth pointing out that this may have implications for other sets of regulations with a similar form.

Once a provisional underlying structure has been arrived at, trying to place the elements of sample regulations in a similar arrangement can test it. When a reasonable fit is found it can be further tested by looking for differences in a particular element between regulations. It has been found that obstacles to agreement about compliance usually lie behind the surface statement of the regulation. Such an obstacle, described in more detail later, is the phrase "capable of being safely used". Where such generalised descriptions are given, an explanatory document is frequently referred to in the regulation which defines certain features that have to be present to satisfy the required condition. As will be seen, it is the description of such features that is often the centre of disagreement.

7.1.2 Difficulties in applying regulations

Difficulties arising in applying regulations, in this dissertation, have been grouped into four categories. Three of these; total failure, general problems of interpretation, and dilution of standards, are found to be of little value for this investigation. The fourth outcome, a large number of formal disputes, has found to be more useful and forms the material for subsequent chapters. To place these outcomes in context the first three groups are described briefly to distinguish them from the fourth:

7.1.1.1 not eliminating conditions the regulation should prevent.

This describes situations about which it is hard to be definite because so many extraneous issues may be involved. These concern not only the original purpose but also the various ways of looking at events that lead up to and follow the introduction of the regulation. It is a group not covered by this dissertation because no useful body of data was found for analysis.

7.1.1.2 interpretative Difficulties

Interpretation is a very general concept. It could be argued that all disputes are problems of interpretation. However, for our purposes it is a process that is involved every time a regulation is applied[1]. The generality of the term prevents it from distinguishing between; difficulties stemming from language; and those arising from legislative boundaries between bodies of regulations connected within the system; or from other causes. Interpretation is so often a matter of judgement that difficulties grouped under this heading are far too general for this present study.

Many of the disputes providing material for the study can be described as problems of interpretation but can also give us useful information because they are focused in a particular disagreement, and the points of disagreement have been recorded, clearly stated and commented upon.

7.1.1.3 wide range of standards

Different authorities and building control officers apply their own understanding of the meaning of regulations to each case that they encounter. Moreover, certain aspects of *The Building Regulations 1985* become 'topical' for a short period. Some authorities will be especially concerned about say, bracing for roof trusses, whereas others are focusing on cavity

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1 "every application is an interpretation" [Schauer91, p. 204]

wall insulation. This is an aspect of control by regulation, which is about localisation of the force of regulations, and raises interesting questions about definition of standards, administrative procedures, and methods of monitoring. However not much data has been found of a reliable nature the area is considered outside the scope of this study.

7.1.1.4 large number of disputes

We can obtain comparative data, where we have documentary information about a large number of disputes. By studying such causes we have obtained material for analysis about the components which make up the complete regulation. This is a reliable source because many of the more difficult cases have been taken through a careful process of analysis and documented with explanations of both sides of the argument.

7.2 CAUSES OF DIFFICULTIES IN APPLICATION

7.2.1 Further analysis of a recorded dispute

The previous chapter described the results obtained from the analysis of a series of documented disputes from one year of selected appeals and determinations published by the Department of the Environment (Appendix B). Two examples show how the process of breaking the regulation into component parts helps to reveal the location and core issue at the heart of the dispute.

7.2.1.1 example of different views of generalised meaning

As an example, the process of analysis is applied to a simple dispute dealing with insulation of

domestic property.[2]

> " The Council had refused to dispense with the requirement of Building Regulation 4 Schedule 1 Part L2 in respect of a new conservatory. The Secretary of State had referred to the drawings in this case and he was of the opinion that the extension was a conservatory and thus exempt from the Building Regulations under Schedule 3 Class VII and he proposal was therefore acceptable."

Schedule 3 Class VII of *The Building Regulations 1985* grants exemption to conservatories from the requirements for insulation. From the brief report of this case, and from experience of similar situations it would appear that the Council were treating the extension as part of the house. The issue is therefore the meaning of the word 'conservatory'. It seems that the Council's view as to generalised meaning which could be applied to conservatories did not include the proposed extension.

7.2.1.1 example showing stages of analysis

In each case reported the relevant regulation was first broken down into the components identified in the previous chapter. The next stage was to identify which of the components contained the reason for the disagreement. The following example shows the result of applying the process to the regulation responsible for the largest number of disputes - those relating to loft conversions (quoted in full - Chapter 6 above). Reference no 7 (see appendices A and B): [3]

Situational Specification:

Domain	dwelling
Sub-domain	materially altered and contains 3 or more storeys
Topic	fire

Response Definition:

Clause	B1(1)b.

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[2] [Appeals/Determinations89, no.40]

[3] [Appeals/Determinations89, no.7]

Purpose	safety to persons in and around buildings

Constraint mechanism:

Entity	means of escape to a place of safety outside
Feature	capable of being safely used
Boundary	minimum - at all material times.

In this case the disagreement centred on the attributes given in a related document *"Mandatory rules for means of escape in the case of fire"* which takes the place of the Approved Document for regulation B1. The Council objected to reliance on a garage flat roof as a 'place of safety' because it had not been given special fire resistance to allow persons to take refuge on it whilst waiting to be rescued. This condition is not defined in the related document so that the Secretary of State had to draw parallels with conditions normally regarded as satisfactory.[4]

In this case the location of the disagreement is in the description of the entity required by the regulation (i.e. a means of escape to a place of safety outside). However, closer examination reveals the reason for the disagreement to stem from a lack of detail about acceptable 'places of safety'. Furthermore, the Council had sought to extend a generalisation about protection of fire escape routes, which was found not to apply in this case. It may be said that the generalisation has become *entrenched* in that it has acquired a special meaning arising out of the convention that escape routes within a structure are usually required to be surrounded by enclosures that have prescribed periods of fire resistance.

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4 "It was accepted that in the longer term a fire in the first floor bedroom beneath the flat roof or in the converted garage could break through the roof and prevent its use as an escape route. However, a similar risk is normally accepted by allowing ladder rescue. No requirement for fire resistance in external walls in the zone where the ladder will have to be set up is made and flames through an open or broken window mean the ladder would be just as dangerous. In fact it would almost certainly take longer for the roof construction to be broken through than it would be for a window to break" [Appeals/Determinations89, p4]

7.2.2 Analysis of recorded disputes

Applying this process to the target group of disputes, it was found that the cause could be traced to one or more of *only four* reasons. These have been used in Appendix B to classify the 146 reports of appeals or determinations.

The results are as follows:

Reason for dispute	Number of disputes	Percentage
Questions of meaning directly arising from use of language	18	8.96
Interaction with recommended procedures or other standards relied upon by drafters of the regulations	48	23.88
Incomplete definitions or circumstances not envisaged by drafters of the regulations	133	66.17
Change in the systems environment of the regulation	2	1.00

The total is greater than the number of disputes analysed because more than one reason applied in some cases.

7.3 ASPECTS OF LANGUAGE WHICH CAUSE DISPUTES

Appendix B sets out results obtained from analysing disputes about the application of *The Building Regulations 1985* showing the reasons for the disputes grouped under four categories. In two of these, the causes are rooted in the inevitable use of language to

communicate written regulations. The first category is about challenges to the exact meaning of individual words or phrases in a regulation. The second category is where there has been some uncertainty about the classification of situations or sets of conditions. These descriptions are invoked, either to trigger a response to the regulation, or to provide details of the response required. In both cases questions are raised about the mechanisms used to convey the intention of the whole or part of a regulation. These questions will come up again in Chapter 8, in discussions about creating different versions of regulations in computer processible format.

In this dissertation it is not possible to make more than passing reference to the many questions about how the use of language creates uncertainty in legal statements. However, in Chapter 3 many of the main factors of language that are at work on regulations are described in the context of legal function: classification and open texture; the role of context; meaning; and the potential indeterminacy of aim of statements in general.

Technical disciplines (such as building construction) develop ways of dealing with these complications. They may have their own language with special and recognised meanings as part of a context specific lexicon, or may use a mathematical approach to representing values and transactions being carried out within the specialised area of discourse. This has a bearing on regulatory control because regulations, normally operating within a narrow field, make use of the generalised language that has developed over time to suit its special needs. These generalisations become entrenched as we saw in Chapter 2 and in consequence words or phrases may be over- or under-inclusive depending on their point of application. Such entrenched generalisations underlie differences of viewpoint between the Local Authority and the Secretary of State in those appeals that are successful.

Problems caused by language have many dimensions, but for our purposes the over-riding characteristic which is of interest is the difficulty of achieving clarity. This is an aspect both of open texture and of classification. It is the elusive nature of exact meaning that is responsible

for so many complications in the business of ensuring regulatory compliance. Disputes about statutory matters are frequently concerned with determining the precise intention of documents, but take place in the knowledge that there is no absolutely dependable version of meaning which can not be challenged.[5] In scrutinising the way in which words of a regulation work together we need to be aware of Frege's view that the meaning of a word can be understood in the most general way only when it is used in a sentence where it is carrying out a particular role and trying to convey a particular piece of information. [6]

7.3.1 Questions about the meaning of regulations

Any answer to the question of what a regulation means has to allow for the fact that whilst words have a core of meaning about which most persons will agree, there is likely to be substantial variation concerning the properties that are essential for the use of a particular word.[7] Furthermore, words standing alone can have more than one accepted usage so that there will be doubt about the subtleties of different and sometimes widely divergent meanings which a single word can have. Consequently, focusing attention on a single word such as 'over' in an earlier example, implies that a particular meaning will be attached to that word for use in similar circumstances in future. The literature on rules and regulations is concerned with complications stemming from the wide range of meanings that can be attached to even the simplest statement.[8] In arriving at an accepted meaning for a work or phrase in

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5 Twining and Miers summarise the principal difficulties in the following terms; words are vague; having only a core of settled meaning, they are ambiguous, having more than one settled use and standing for a range of diverse, though related things, in any account it is possible to substitute a more specific or more general description.[Twining/Miers91 p222]

6 [Dummet92]

7 Wittgenstein and the meaning of the word 'game'. [Sowa84, P.15]

8 Twining and Miers give as example of a rule which states "no vehicles in the park" which seems clear enough at

regulations it is usual to look for acceptable precedents that can give guidance about the exact meaning intended. The context of the regulation, containing allusions to associated legislation and related standards, is a usual starting point for arriving at clarification.

The significance of this problem is illustrated in the following example.

7.3.1.1 a dispute about meaning

Consider for example, an appeal[9] in which the exact definition of 'maisonette' was challenged by the local authority. The building in question was a large house having been converted to provide 9 self-contained flats. The top flat was entered from the floor below and the council invoked clause 3.2.3.1(2) of the Code. This clause is invoked by the Mandatory Rules relating to this regulation. The definition of maisonette in the Mandatory Rules is given as "a dwelling occupying two floors". Nevertheless there is some ambiguity, in the case reported, regarding the point of entrance. Although no habitable rooms were situated at the entrance level, questions of fire safety were raised by the need to descend an internal staircase before reaching the fire-protected staircase. This route formed the only means of escape within the building. The Secretary of State applied the literal interpretation of the regulation because all the accommodation was to be on one floor. He therefore considered that the alterations to the building were acceptable. In this situation, the response definition is only applicable if the situation proposed is embraced by the sub-domain 'maisonettes' of the regulation. The Secretary of State took the view that this was not so. The 'sub-domain' of the regulation relied upon a generally accepted meaning. This interpretation was insufficiently precise for the alternative version of the regulation proposed by the local authority to be excluded until

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first sight until taking into account things like invalid carriages or skateboards. Schauer takes this hypothetical rule even further by questioning whether a statue of a vehicle would be allowed or even an ambulance coming to the scene of an accident.

9 [Appeals/Determinations89, no.30]

the appeal was heard. This example shows how a case draws attention to a particular element of a regulation and shows what function it performs.

7.3.2 Inevitability of vague classification

As we have seen earlier, one of the fundamental jobs in drafting regulations is that of describing, in unambiguous terms, the relevant characteristics of situations, events or objects. Both the situational specification and response definition depend upon precise classification of situations and working practices to carry out their function. As we saw from the above table of results, most of the disputes examined had as their cause, doubt about certain descriptions given in the regulations. Pinpointing the words or phase responsible for the uncertainty gives clues about the function of that part of the regulation.

Twining and Miers[10] point out the special part played by *class words* in communicating formulations of rules:

> "If it were not possible to communicate general standards of conduct, which multitudes of individuals could understand, without further direction, as requiring certain conduct when occasion arose, nothing which we now recognise as law could exist. Hence the law must predominantly, but by no means exclusively, refer to classes of acts, things and circumstances; and its successful operation over vast areas of social life depends on a widely diffused capacity to recognise particular act things and circumstances as instances of general classifications which the law makes."

There is a close connection between classification and the notion of open texture.[11] Hart has argued that rules can never be perfect because of their: "*open texture*.. a general feature of human language: uncertainty at the borderline is the price to be paid for the use of generally classifying terms in any form of communication concerning matters of fact. Natural

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[10] [Twining/Miers91, p220].

[11] Schauer mention the example of the exploding goldfinch postulated by J. L. Austin as being a situation which defies description in terms of our current understanding of the world.

languages like English are, when so used, irreducibly open textured." [12]

Twining and Miers point out that: "legal rules suffer from the problem of indeterminacy, indicating that it is often difficult to predict the scope of those rules." They emphasise that the implication of this situation is that there is no guarantee that future persons trying to arrive at the meaning of a rule will come to the same conclusions as the people who drafted it in the first place. The 'cessante' maxim mentioned by them makes the point that ".. indeterminacy of aim is only one aspect of why reasons for rules may give rise to conditions of doubt or may be of limited utility in resolving such doubts."[13]

7.3.3 Implications for internal structure

We need to be aware of the potentially unexpected influence of language to make the best use of information derived from disputes about a particular element of a regulation.

The main factors are:

- classification of situations and physical objects has a special significance in creating and applying rules and regulations[14]
- the open texture of language implies that there are core meanings to both words and phrases which can be generally accepted but which become harder to pin down as we move away from the core meaning
- meanings are susceptible to change over time.

Many of the above phenomena are explained by the presence of generalisations and entrenched meanings. This is especially true when words or phrases take on layers of over- or under-inclusiveness which may be a consequence of lack of detail, thus modifying the function intended by the drafter for a part of the regulation.

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[12] [Twining/Miers91 p200]

[13] [ibid. p211-214]

7.3.4 Context of regulations

Dependence of regulatory statements on context is a facet of the use of language made harder to grapple with because it is frequently implied rather than explicitly stated. In the special case of legal processes there are two contextual issues. The first concerns the legal framework which supports each regulation; superior legislation, case law, related legislation and accepted meanings for legal terms used. The second, is the pragmatic knowledge context behind descriptions included in the regulation. *The Building Regulations 1985* assumes a certain level of industry knowledge and experience to understand the terms being used.

However we can see from the nature of the arguments presented in the reports of appeals and determinations that apparent experts can put forward arguments which in 81 out of 143 cases are set aside by a higher authority. Many of the cases reported involved relying on knowledge outside the actual wording of the regulation. This knowledge is either implied in the context of each of the parts making up the regulation, or expanded by reference to a supporting document.

A further way of dealing with the phenomenon of context when drafting a regulation is to attach special meanings to words or phrases which act as a pointer to a wider context. A result of this technique is that users of regulations are sometimes confronted by an alien flavour of language having a highly technical context into which the regulation fits. Representations of the internal structure will require similar pointers to generate appropriate contextual references if they are to support sensible interpretation techniques.

The issue of context has a bearing on the respective standpoints of the generators of the statement and that of the recipient. In this sense it connects with concepts about communication as a process. Communications theory emphasises that the role of the

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[14] [ibid. p220]

receiver of a message which is being sent is both active and passive. Drafters of regulations can reasonably expect that persons trying to interpret regulations will make more effort to comprehend their intentions than in normal exchanges of information.

Apart from semantic considerations, special complications may arise with syntax because of the parallel between the grammatical structure of the actual regulation and the internal structure we are trying to detect. The primary example is 'syntactic ambiguity', a condition which arises when a statement has been constructed in a form which is capable of more than one interpretation. Holland and Webb[15] claim that "in practice, such instances of ambiguity have to be resolved by the courts choosing one of a number of competing interpretations, and even sometimes by amending the ambiguous construction."

There are many other matters about the relationship between syntax and internal structure that could be explored, but for the present it is considered sufficient to point out that it can be an obstacle to conveying the exact intention of the regulation.

7.4 THE INFLUENCE OF THE LEGAL ENVIRONMENT

7.4.1 Interaction between procedures or other standards

The legal system is one of the environments in which regulations exist. *The Building Regulations 1985* are brought into effect by an enabling act or Statutory Instrument, and sanctions are tied in to the due processes of the law. In the sample used, interaction between regulations and their statutory environment was the reason for 48 of the problems analysed. It is an area that creates special difficulties by presenting more than one possible interpretation

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[15] [Holland/Webb92]

for the situational specification or by altering boundaries imposed by the response definition. New regulations must mesh with the extensive body of legislation, which already exists, and because of the sheer number of statutes important links may be overlooked. Keeping regulations in step with each other is a problem creating further difficulties as revisions are made[16].

Whilst the operation of the law allows for interpretation by the courts, regulations are usually less controversial because they are dealing with situations which have been defined as narrowly as possible by enabling legislation. Regulations are normally of a fairly technical nature with a more sharply defined vocabulary taken from the industry or affected domain. There is an expectation that where disputes arise they can be argued in terms that will be understood by both sides. Being less open-ended than general law implies greater precision within regulations that may be at odds with the more open presentation of general legal statements. In the cases examined the main difficulties are created by trying to apply criteria which have been set up from different points of view or which are trying to deal with different concerns (as an example see ref. 98 in Appendix B).

Holland and Webb define the operating environment of delegated legislation (regulations) as the parent act (in this case *The Building Act 1984*) and the Common Law.[17] They state that the parent act is of "central importance in defining meaning" but that courts may resort to the Common Law where the act is silent on a key point. They also state that the "operation of whole areas of law, such as social security and immigration is dependent upon a network of regulations, which will be of greater day-to-day significance than statute". The construction industry is no exception, and there are over 50 sets of regulations that may impact on the

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[16] [Appeals/Determinations89, nos. 34 and 98]

[17] [Holland/Webb91 p.186]

erection or alteration of buildings. Interaction between an individual set of regulations and its supporting legal environment creates potential hazards for the straightforward application of each of the regulation's various components.

The particular difficulties associated with the interaction between a regulation and related legislation are illustrated by a case concerning the installation of toilets in bedrooms for the elderly[18]. The provision of sanitary conveniences is covered by regulation G4. This states that

> Sufficient sanitary conveniences shall be provided which shall be -
> (a) rooms separated from places where food is stored or prepared and
> (b) designed and installed so as to allow effective cleaning.

The Approved Document (para. 1.5) gives requirements for the siting of appliances. The Council had rejected the proposal on the ground that it did not comply with the guidance given in BS6465 Part1:1984. The Secretary of State considered that the proposal complied with the requirements of the response definition included within the regulation. He stated that it was not necessary also to comply with the alternative arrangement, which he pointed out is for guidance and not a requirement. Since there had been no suggestion by either party that the regulation did not apply, the case referred to deals with the response definition of the regulation and relates to its legislative context.

Here we have two ways of ensuring compliance: that given by the stipulations of the regulation; and an alternative. The wording of the approved document would appear to be quite clear in relation to the application of the alternative approach which can be adopted if preferred. However because the British Standard is more explicit in describing its

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[18] [Appeals/Determinations89, no.115]

recommendation for the installation of sanitary appliances it may be taken as a more useful guide to satisfactory provision. It was found by The Secretary of State that the proposals met one of the regulation requirements. Presumably if only one solution had been permitted there would not have been a dispute about the kind of response which would represent satisfactory compliance.

There are a number of other cases of a similar nature in the analysis of appeals and determinations where reference to an associated regulation or standard has cast doubt on precise interpretation. In modelling similar circumstances, some indication of the priority to be attached to alternative or expanded requirements should be included.

7.4.2 Interpretation

Regulations are different from other written prescriptive rules, such as the 'Rules of Golf', in that they are part of a network of statutes that lay down the scope of the regulations and define how they are to be interpreted. Writers[19] dealing with problems with regulations from a legal point of view usually focus on questions arising from interpretation. They also suggest there are three ways of looking at interpretation: taking the wider impact of law into account; legalistic interpretation; and contextual interpretation. They argue that the standpoint of the interpreter has a bearing on the way a problem is tackled. For example interpretations in the domain of common law tend to be 'bottom-up' as opposed to those covered by Civil law which rely on working from general principles.

Four factors need to be accounted for in relation to the legal environment in which regulations sit:

1 the nature of the interface between a regulation and its legal framework
2 how much the existence of an external legal framework contributes to problems

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[19] [Twining/Miers91 and Holland/Webb91]

with regulations

3 identification of difficulties which stem from this situation

4 where in the regulation such difficulties impact

7.4.3 Complications stemming from related legislation

Regulations are either created directly by an Act of Parliament or as a secondary process via an enabling Act that establishes the right of an appropriate government department to generate them. As such they are drafted by personnel who specialise in producing regulations; who work within normal workload constraints, and to instructions which may place greater emphasis on political outcome than on the excellence of a particular mechanism of regulation. As Twining and Miers state: "Political compromise and short-term expediency are also natural obstacles to neat rationalistic law-making". There may be some conflict between the overall purpose of the enabling Act and the subordinate regulation.[20] Much has been made of the difficulty of working out the original intention of a particular regulation.[21]

Dworkin[22] has drawn attention to the difference between the written contents of a statute and the underlying or commonly held view of its intention - the "real" meaning of the legislation. Commentators seem to agree that a generally understood version of the original intention behind a regulation will be helpful in interpretation. However, in relation to design of regulations by collegiate rule-making bodies Dworkin asks[23]: " can there be such a thing as a shared intention? " Such differences in standpoint are part of the complications introduced when one regulation refers to another. In addition there are practical difficulties involved in

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[20] [Twining/Miers91 p328]

[21] [ibid. p202-7]

[22] [Dworkin86, chapter 9]

[23] [ibid. chapter 6]

retrieving all relevant legislation and coping with risks of omission, particularly where there have been amendments.

In addition to the above influences of related legislation there is a further aspect of interpretation created by the Interpretation Act 1978. Although the application of this act is outside the scope of this investigation it must be noted that litigation may introduce a new perspective on the application of mandatory requirements. For example, there are two distinct questions to be settled when considering situations from a legal point of view - do they involve questions of fact or of law. Questions of fact deal with the supposedly incontrovertible aspects of the matter. However, questions of law deal with, for example, the range of meanings that can be attached to a word that has a specifically legal meaning attached to it.[24] There have been no court cases about the application of *The Building Regulations 1985* to assist in evaluating data taken from disputes.

7.5 INCOMPLETE DEFINITIONS

Analysis of DoE Appeals and Determinations found that the disputes dealt with the relevance of either the situational specification, or of the implications of the regulation when applied to a given situation. From examination of the generalisations contained in the relevant part of each regulation it can be seen that some part of the definition is incomplete in terms of specification or detail. Of these gaps or omissions, 27 were concerned with the situational specification and 106 with some aspect of the response definition or constraint mechanism. In relation to the number of appeals and determination, there is a large number of disputes stemming from deficient classifications. They provide useful examples for comparison

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[24] [Twining/Micrs91 p178 etc.]

making it possible to look for subtle variations.

The frequent occurrence of this reason for a dispute draws attention to the likelihood of gaps in regulations which are caused by either a direct omission or by a qualification which modifies the scope of the part in question. Many of the omissions are only made obvious when the regulation is challenged.[25]

The examples, which follow, give some indication of the kind of descriptive detail that can be found lacking when examining a particular part of a regulation. In many cases the absence of necessary information is found when the words used in the regulation are expanded by reference to Approved Documents or similar supporting material. A phrase like 'place of safety' may be given a series of attributes that must be present in order to be considered acceptable. In other situations, too narrow a description of acceptable features has been defined, and it is discovered that the circumstances of the proposal under consideration have not been catered for.

7.5.1 Example of under-inclusiveness

As an example let us look at a request for a determination[26] dealing with the question of whether a proposed multi-storey block of offices would have too great an unprotected area (usually glazing) adjacent to its boundary. Two types of building, shops and industrial, are regarded as having a high notional fire load which requires considerable restriction on the amount of unprotected area near to the boundary of a site. However, in the case of these two building types, if sprinklers are installed, twice the amount of unprotected area is permitted. In the case quoted, the applicant took the view that if sprinklers are installed, a similar

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[25] This is similar to the function of case law in general legal practice, in which new circumstances are explored by the judiciary to develop understanding of how the law should be applied.

[26] [Appeals/Determinations89, no. 108]

concession should be granted to offices. The issue here is the scope of the situational specification and whether they include, or do not include, office buildings. The Secretary of State determined that the concession should also apply to office buildings, thereby modifying the scope of the regulation for this particular building.

This example illustrates the difficulties in ensuring that the right conditions are matched to the response definition of the regulation in each part of the regulation. By drawing attention to the effects of under-inclusiveness it demonstrates two points. Firstly, the drafters of the regulation do not appear to have matched their approach to buildings with a high fire load to the description of requirements applicable to granting concessions. Secondly, the sub-domain of a regulation is an identifiable component, essential to the correct application of that regulation and requiring careful definition to take into account all known variables which for which it might have to cater.

A second example[27] relates to regulation B1 - Means of Escape, an area that has already been mentioned as being highly contentious. Under Regulation 5(a) a material change of use takes place when it is proposed that a building should contain a flat where previously it did not. Providing the building is three storeys or more, Regulation 6(1)(a) states that Regulation B1 will apply. However section 2.1 of the supporting document, the 'Mandatory Rules for Means of Escape in the Case of Fire' states that it only applies to a 'building which is being erected'. A view expressed in the report (and probably emanating from the DOE) is that "although the words say 'is being erected' one must read as if in this case it included 'is erected' ". This is clearly a gap in the domain section of the situational specification part of the regulation which could have been closed by a description which matched more closely the situation of buildings affected by the regulation. The location and influence of this qualification is shown in

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[27] [Building Control, May/June 1986 p29]

example C1 in Appendix A.

A further example,[28] also involving the situational specification, concerns a case referred to the Secretary of State for determination regarding the classification of a residence for elderly people. The Council (Building Control Authority) considered that the building would be of 'institutional' use, a classified building type, whereas the applicant defined it with an alternative classification - 'other residential'. The significance of the classification is that it affects the level of fire resistance to be provided for intermediate floor construction. The Secretary of State agreed that the building should be regarded as 'other residential' on the grounds that "old age is not in itself a disability". The lower value of fire resistance was deemed acceptable and this decision clarified the sub-domain of the regulation.

7.5.2 Example of incomplete specification

A final example of a gap in a building regulation[29] deals with provision of spiral staircases. Part K [30] possibly the simplest and most fundamental requirement of all in the Regulations covers the design of staircases. The Approved Document, which elaborates on the basic clause, includes a diagram (6b) showing tapered steps, which does not illustrate the most common situation. It portrays a portion of a circular newel post whereas the usual shape is square. As a result it is not clear what is required by the regulation in conventional staircase design and leaves the precise effect of the constraint part of the structure unbounded.

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[28] [Appeals/Determinations89, no. 80]

[29] [Building Control, March/April 1986 p38]

[30] "Stairways and ramps shall be such as to afford safe passage for the users of the building"

7.5.3 Implications

Following the arguments from similar cases, it is found that the causes of disputes lie mainly in the qualifiers of the words or phrases, which are part of the formal regulation. Representations of the underlying structure will therefore need to show those qualifications that apply.

7.6 CHANGES IN THE SYSTEM'S ENVIRONMENT

7.6.1 The status of the original regulation

The proportion of Appeals and Determinations which appeared to stem principally from new circumstances or from conditions arising which were not envisaged by the drafters of the regulations is small - only 2. Although insignificant in relation to the other causes noted the cases are of interest because they help to confirm the systems view that regulations are drafted in the context of known circumstances. New conditions such as the introduction of new materials, forms of construction, building types etc., introduce factors that can lead to a regulation being challenged as no longer appropriate in the new situation.

The main issue here is that the original regulation was created against a background of inter-relating circumstances, some social and some technical, with the intention of reducing a risk of undesirable situations which had either already occurred or were considered as probable risks for the future. The final regulation will have been based on a convergence of compromises balancing a wide range of matters that were perceived as bearing on the main issue.[31]

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[31] [Holland/Webb92 p 146]

7.6.1.1 example of new types of space

This condition is demonstrated by a case[32] covering the problem of spread of fire in concealed spaces. The regulation B3(3) states:

> "concealed spaces in the structure or fabric of the building, or the building as extended, shall be sealed and subdivided, and where this is necessary, to inhibit the unseen spread of fire and smoke."

The case under consideration was to determine whether the area above a suspended ceiling should be regarded as a 'concealed space'. The dispute arose over the provision of cavity barriers to seal and subdivide a void created by a suspended ceiling being installed over a retail area. The suspended ceiling in question did not extend over the whole of the shop floor area and the space above rose to a height in excess of three metres above the ceiling plane. The applicant took the view that the ceiling was not a concealed space because it was open-ended, and did not continue over the whole floor area. The Secretary of State agreed with this view.

When the original regulations were drafted this was probably not a situation that was considered likely to occur and response definition reference to the illustrations in the approved document show only fully bounded spaces of conventional construction. Nevertheless, the use of suspended ceilings, which do not extend over the whole floor area, has greatly increased in the past few years in all types of public space. Whereas it could be argued that the failure to describe suspended ceilings in these circumstances led to an incomplete regulation, it seems more reasonable to classify this as a situation which has arisen from new approaches to design and is therefore outside the original frame of reference.

In this example the main subject under consideration is the void above a suspended ceiling and the way in which it is described. This is the core entity within the regulation template and the careful examination of the definition shows that it was quite specific and not flexible

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32 [Appeals/Determinations89, no. 102]

enough to cope with changing circumstances. It also emphasises the existence of the controlled entity within the response definition section of the template.

7.7 CONCLUSIONS

The aim of this chapter has been to demonstrate the extra information which can be obtained by looking at the cause of cases where a formal dispute has arisen and where both sides have taken care to present developed arguments. Analysis of such cases enables decisions to be collected into groups with similar attributes. In this way aspects of internal structure are rendered more obvious and the basis for a more detailed investigation is created. It has been found that most disputes arise in areas where the situational specification or response definition have been incompletely defined.

This chapter, together with the previous one, is intended as a preparation for exploring implications for the possibility of computer representations of legal statements. The results of the analysis of the disputes suggest that depicting regulations to investigate internal structure will need to account for generalisation, entrenchment, and over/under-inclusiveness.

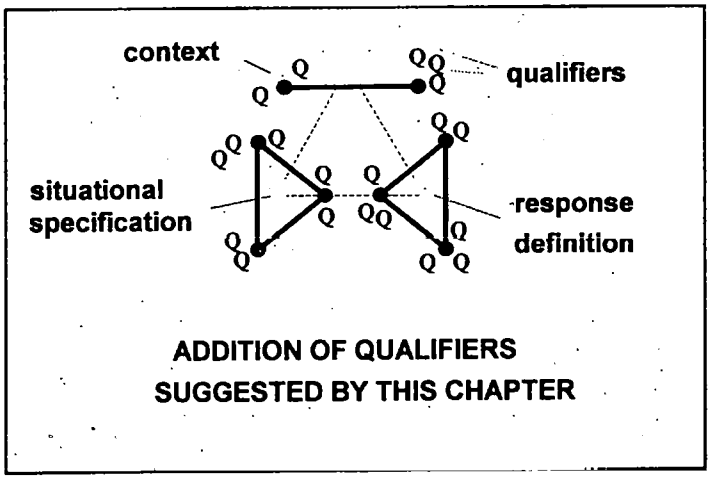

FIGURE 7.3

The above diagram illustrates the location of the extra detail that has been extracted by establishing the factors at the root of the disputes. It provides the basis for building a representation able to account for internal structure.

CHAPTER 8 REPRESENTATIONAL COMPLICATIONS

Abstract

The main characteristics of a regulation that must be present in a computer representation having been identified, this chapter discusses issues raised by various techniques for converting regulations into different formats.

Before focusing on frame representation techniques, options available for storing regulations in computers are described: database methods; production-rules systems; conceptual dependency; and parsing processes. Each is reviewed in the light of the present investigation, from earliest attempts at depicting a regulation through to the final definition of the required data structure.

The strengths and weaknesses of each are compared with the relative advantages of the method finally selected. The main obstacles to accurate representation are shown as being: difficulties in obtaining exact meaning for single words such as nouns, and depicting the existence of component qualifiers - generalisations, and entrenchments contained in the wording of regulations.

The chapter concludes with a specification for the appropriate template, which is expanded upon in the next chapter.

8.1 INTRODUCTION

The last chapter left us with the question of how to go about reflecting the internal structure of regulations in a computer processible format. In accepting the potential for the use of computers to process regulations we need to answer two further questions: how can they deal with the problems underlying disputes identified at the end of the last chapter, and what additional complications may be created by this approach. It was shown in Chapter 3 that the main obstacles to depicting general law statements come from the open texture of language, and from difficulties inherent in precise classification of the nature of given situations. These problems are compounded by changes to the environment of the regulation, which continue to arise, with the result that a historical viewpoint will never provide a complete picture of relevant issues. As we have seen in chapter 3, it is by no means generally accepted that legal statements, together with any subsequent modifications, can adequately be expressed in any form other than the original wording. However, the suggestion has already been noted that there are grounds for assuming that analysis of regulations by computer is a useful tool for understanding regulations. This is especially applicable to those people who are not trained in the interpretation of legal statements and who might benefit from access to a form of on-line computer-generated legal advice.

Mital and Johnson have stated that systems which reason with statutory (or regulatory) provisions have proved more successful than those involved with case law [1992, p215]. In addition to simply storing regulations, it is also necessary for those interpreting the law to be reminded of changes which may be implied by case law that occurred after the regulation was came into effect. This raises the question of how to merge the two streams of influence into a single guide for those affected by a particular regulation, or set of regulations.

This chapter begins by examining the restrictions created by the use of databases and the distinction between them and knowledge bases. Some of the tools used for knowledge representation are reviewed to illustrate the extent to which they interfere with representation methods. Production systems, techniques for natural language processing and frame representations potentially offer means for creating alternative versions of regulations. Schank's work in connection with conceptual dependency is an additional reference point for comparison with legal statements by analysing basic concepts within statements to create a semantic for breaking down statements about situations.

There has been a great deal of progress in the understanding of computer processing of natural language and this subject is a background to considering storage of regulations on computer. Natural language processing has reached a sophisticated level in which, theoretically, most parsing problems have now been addressed and significant inroads have been made into questions of semantics.[1] Parsing techniques have advanced dramatically in recent years and may offer an alternative means of testing regulation structure. However, the degree of sophistication required to address the subtlety of generalization and entrenchment is considered too complex for the simple prototyping techniques needed to illustrate the concepts put forward in this study.

A large amount of recent work in developing computer representations of real world situations has been based on one of many versions of 'frame' formats. Different approaches to this concept are described and alternative formats examined to illustrate the strengths and weaknesses of each for modelling regulations. Many knowledge representation procedures are built around the reasonable expectation that logic provides a good basis for expressing the truth of certain statements. This chapter finds that much of the progress

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1 Writing about natural language processing Covington says: "Parsing of English has been studied extensively, and some NLP researchers consider it practically a solved problem" [Covington94 p.8]

with semantic representations has used the symbology and general structure of first order logic. The process of translating regulations in this manner is effectively providing alternative language which both adds to our understanding of regulations and at the same time presents new risks of over-simplification and fresh errors of interpretation. However, it is argued that beneficial insights are obtained by so doing and a specification is outlined, which takes these limitations into account.

8.1.1 Computer Representation of Regulations

Having made it clear that the subject of regulations is complex because of the wide range of regulations in existence and divergence of opinions about what constitutes a regulation, an obvious question is: why further complicate the situation by converting them to a computer-processible format?

For the purposes of this dissertation there are three main aims. Firstly to permit comparative analysis to facilitate computer processing of regulations. Regulation style, content, and method of expression are areas where useful information could be obtained if convenient methods existed for comparing sets of regulations. Secondly to confirm how regulations can be divided into suitable components to search for patterns of internal structure. The shape of different regulations and individual clauses can yield useful data showing how varied regulatory environments are reflected in the internal structure of the associated regulations. Thirdly to obtain a basis for testing ideas about the operation of regulations, and in particular to look for explanations of disputes. This will help to confirm that the representation of internal structure deals adequately with the subtlety of the arguments put forward by the disputants.

In addition there are more general reasons for putting regulations into a computer processible format. An obvious use is constructing retrieval systems able to find regulations relevant to a particular situation. This could be used for checking the necessary

scope of a new legislation and related regulations to minimise the number of unintentional overlaps between related sections of legislation. A second reason for using this approach is to extract the constraint core to assist design decisions or for checking purposes. This is described more fully in chapter 9.

The Artificial Intelligence community continues to test ideas of philosophy, logic, and reasoning strategies using a variety of techniques, which lie, outside the scope of this study. In the last decades, techniques of knowledge engineering have developed methods that are coming into general use, for example in process control information management. It is conceivable that research into regulation structure will have potential application in providing an intelligent computer assistant, which might evolve into a useful and dependable resource for supporting decision making in an increasingly regulated society.

8.1.2 Text retrieval and the LEXIS[2] system

A number of conventional legal information retrieval systems, whether for legal research or litigation support rely upon text retrieval. In this process an index is created containing the location of significant words in each document. The index is then used for finding documents containing a particular word or phrase. In more complex systems these may be weighted on a statistical or other basis to provide more flexible access. This process does not provide for conceptual understanding of the text in the memory store and relies on the operators of the system to add this through classification and cross-referencing. For example, such an approach may record, by means of an appended commentary, how a new act amends existing legislation, or even how a word has been defined. Libraries and the larger legal practices are using the technique for collecting together information on particular topics or case issues.

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2 [Lexis]

The most widely used system for text retrieval in the legal profession, the 'Lexis' service, is a facility available on subscription. This service gives keyword search access to current Public and General Acts of England and Wales. It also offers the full text of over 100,000 reported and unreported case law judgements. In addition, published material dealing with legal developments and selected articles from UK Law Journals is stored. Complete written documents are stored on computer and classified into appropriate categories by a front-end database management system to simplify access. Keywords or phrases can be entered and the computer offers a list for further selection. In this way it is possible to achieve fast assembly of relevant statutory legislation or legal cases for further study.

At present, text retrieval systems do not attempt automatic conceptual processing. Information is retrieved on the basis of direct word matching, or from a membership of a lexicon of word equivalents. The technique therefore does not have anything to offer in the search for internal structure of regulations.

8.2 DATABASES

Even in the simple task of comparing the suitability of insurance policies, in trust for a particular client, a database listing salient features of the available products is only a start.

> "... an attorney providing the advice still has to go to the insurance handbook and read page after page. When middle to high-income clients are being dealt with, and the advice in respect of the insurance policy is part of a wider exercise in estate planning, the professional will demand more support from a computer. A kind of support which means, for instance, rich information structures and resort to knowledge system techniques."[3]

Most databases in general use store information in discrete tables that are related together by pointers setting up relational links. This mechanism requires the data they contain to be

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3 [Mital/Johnson92, p.18]

organised in a fixed schema designed to suit a particular situation. Extracting information involves a query technique using a limited range of formats to obtain comparative information about the contents of the database. This method confines transactions to range foreseen at the time the original schema was constructed. Mital and Johnson point out that:

> "...gradually however the field of databases has been shifting (away from the black box approach) and evolving to incorporate many of the ideas inspired by development of knowledge systems.....in fact it has been predicted that rather than adopting some modified relational model, the industry - IBM, has heavy investment in DB2-based tools - will opt for an object-orientated database model by the late 1990s."[4]

8.2.1 Database management systems

The scheme of information organisation is intimately linked to envisaged outputs.

Referring to database management systems Frost says:

> "Unfortunately currently available DBMSs are not ideal. Although researchers are developing fully automatic components, no single DBMS has yet been produced which can automatically generate a complete database system from its specification. In general, the DBMS user must become involved with implementation details as well as system specification. In particular, the DBMS user must be fully conversant with the data storage structure underlying the particular DBMS being used (largely because of the common absence of a logical to physical mapping module)".[5]

Frost summarises the limitations of existing data management systems:

- data independence is not supported
- co-existence of external schemas is not supported
- semantic integrity checking is not automatic
- deductive retrieval is not supported
- end user interfaces are not very friendly
- most DBMSs are based on inappropriate hardware.

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4 [ibid. p.19]

5 [Frost86 p.84]

Most use is made of relational databases which represent the subject area as consisting of entities, entity sets and relations. Categorisation of entities is into discrete fields, which creates direct limitations for the relational model of databases. Their impact is on defining relationships between loosely framed meanings of words or phrases where the boundary classification of entities has not been fully determined. In general, therefore, databases, although they are quickly searched by electronic means, may be seen as an extension of the record card approach to storing information.

8.2.2 Database methods compared with knowledge based approach

However, as knowledge based systems have developed the distinction between the more sophisticated database approach and knowledge based systems has become less distinct. Brachman and Levesque suggest that:

> "the interaction between knowledge representation and databases is better considered at a more fundamental 'Knowledge Level'. Under this view, databases are seen as large knowledge bases of a certain limited form. This limitation in representation form can be motivated by a fundamental trade-off that all knowledge representation and reasoning systems are faced with."[6]

Zaniolo et al.[7] uses Prolog to give an example of the distinction between simple recording of facts and a structure representing minimal knowledge. The first of these can only hold and report colours of those objects where information about colour has been stored as a series as facts in the following form:

```
print colour (snow) :- !, write ("it's white.").
```

The second method links the colour to the material. Information about colour is then

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6 [Brachman/Levesque86, p.69]

7 [ibid. p.70]

extracted relying on a simple rule about the association of colour and material.

```
colour (snow, white).  colour (grass, green).

print colour (X):-  colour (X,Y),!,  write ("it's"), write (Y), write (".").
```

The incorporation of a rule marks the distinction between the two approaches to recording information. This shows how the advantages of using formal logic to record the contents of a knowledge base can give a basis for a flexible method and a facility for precise definitions using theorems of first order logic which have been refined over a long period. In summary, the approach of Zaniolo is that conventional database management provides users access to pre-structured data rather than using the data to answer questions about the world. However, the increased sophistication of relational databases coupled with the introduction of object-oriented techniques suggests that the boundary between the more refined DBMSs and knowledge bases will become less distinct.

Cammarata and Melkanoff make similar points: [8]

> "current DBMS..... do not have adequate facilities to maintain heterogeneous data. Current commercial systems have evolved from record and file-based systems to hierarchical and network set/owner models and most recently to flat relation models. Given this heritage, the predominant data structure is still a strictly typed, textual record. As such, current systems are best suited for applications with homogenous, well-structured data such as numeric business data."

They stress that most DBMS adhere to a static schema definition, which creates significant re-configuration overheads when modifications are needed. They refer to the lack of expressive power in existing implementations of various data models particularly in relation to CAD/CAM data involving many complex and part-specific relationships.

Early in this investigation, attempts at representing building regulation structure using

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8 [Cammarata/Melkanoff86, p.425]

memorandum fields to store qualifying clauses produced statements greatly restricting the kind of query possible. In effect the query process was limited to recognition of a series of words because the database returned an answer only if case and spelling were identical.

8.2.3 Comparison with Artificial Intelligence tools

Despite the convergence of relational databases for conventional use and databases to support Artificial Intelligence (AI) applications, they continue to have functional differences. Knowledge stored in databases to support AI experiments is frequently as a collection of typed slot-filler objects, similar to records in Pascal or structures in C. These objects combine data about entities and events with knowledge rules to infer further information from the facts stored. Databases within AI systems normally require a rule base using variables and meta-rules processes quite distinct from conventional database systems. Conventional databases have difficulty in holding AI data because of representation problems with: variables in queries and data; querying within data and stored in the database; and contact stacking for backtracking.

Frost[9] provides an overview of knowledge-based tools which was used as a check list; use of formal logic, theories for dealing with uncertainty, production rule-based systems, slot and filler knowledge representations. His comparison of database concepts confirms that differences between programming languages and knowledge processing activities in general show that some are more suited to particular application areas that others. The subject of knowledge-based tools for processing natural language is so large that only a small proportion has a bearing on the particular question of deep structure within legal statements. The contents list of the proceedings of the Tenth European Conference on

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9 [Frost86]

Artificial Intelligence[10], August 1992, Vienna, Austria shows how many different tools and modelling systems are available.

1) automated reasoning, including constraint satisfaction *(relevant to the internal structure of regulations)*
2) cognitive modeling
3) connectionist and PDP models for AI
4) distributed AI and multi agent systems
5) enabling technology and integrated systems
6) knowledge representation *(relevant to this study)*
7) machine learning
8) natural language *(relevant to this study)*
9) philosophical foundations
10) planning scheduling and reasoning about actions
11) robotics
12) reasoning about physical systems
13) user interfaces
14) vision and signal understanding
15) verification, validation and testing knowledge-based systems

Aspects of processes 1, 6, and 8 have been used in tackling the following tasks:

1) separating the regulation into its principal components

2) providing comparison between various components to find patterns and relationships

3) increasing understanding of open texture of regulations

4) drawing attention to generalization and entrenchment

5) suggesting ways of identifying the difference between hard and easy questions

6) examining the distinction between rules and principles.

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10 [ECAI92]

8.2.4 Representational limitations

Each of the different techniques available creates some limitations for the ways in which regulations can be expressed. Hayes[11] argues that the main complications are: linguistic and direct representations; evidential reasoning; logical problems associated with that topic and control; and depicting substances, parts, and assemblies. Central to his argument about slot and filler representations, including frames, nets, conceptual dependency structures and scripts, is the necessity for associating representations of meaning in relation to some domain, world or environment. Hayes places emphasis on the use of formal logic, referring to a number of special logics developed to deal with representational problems, particularly in relation to time and non-monotonic reasoning. The issues he raises make it clear that allowances must be made for processing limitations when selecting the most appropriate method for storing regulations to be manipulated by computer-based methods.

Target regulations were entered in a variety of formats into database record to review the possibility of using a standard data management system for their analysis. The tests confirmed the large amount of preliminary analysis needed before being able to select essential constituents of regulations. Furthermore, tabular forms of representation allow no facility for making connections between entries within each field, as can be seen from the following example:

CONTEXT	DOMAIN	ENTITY	REQUIREMENT	FEATURE
health of persons in buildings	dwellings	foodstore	shall be	capable of being ventilated

This method for recording regulation content has the advantage of demanding explicit answers to consistent questions and in an ordered fashion, but is difficult to maintain and

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11 [Hayes85, p.3 onwards]

does not allow for inheritance or storing appropriate default values.

8.2.5 Classification and representation

Classification is one of the central issues in trying to represent knowledge, and is at the heart of the descriptive nature of regulations. This problem is emphasised by difficulties in deciding classificatory boundaries when constructing databases that include objects that are part of others. Corella[12] looks at the complex issue of retrieval of concepts and how these can be classified using examples taken from an electronics parts catalogue. He also regards logic systems as part of the techniques contributing to solutions referring to the theory of sets in the role of categorisation. Questions of subsumption as a factor in classification are mentioned and he suggests that taxonomies can be regarded as composite objects useful for organising and sorting information. There appears to be a large consensus to support the use of first order logic and its derivations as a method for dealing with semantic issues and entrapping meaning, a view which supports the use of Prolog as a language for analysing regulations.

Frost lists the key features which distinguish knowledge base systems from DBMS., defining knowledge as "the symbolic representation of aspects of some named universe of discourse". Reminding us about difficulties and ambiguities inherent in natural language when compared to the record-card-like structure of database systems, he mentions other techniques that may be useful for creating computer processible formats for regulations. They are: Backus Naur format for expressing syntax propositional logic; predicate knowledge for expressing information about individuals; and classes of individuals and first order logic for handling generalizations.

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12 [Corrella86, p.94]

8.3 PRODUCTION-RULE SYSTEMS

The 'production rule' technique is one that offers greater flexibility than relational database management systems and has been used as a basis for many expert systems.[13] Production-rule systems make use of the conditional statement 'if X, then Y' to assemble knowledge bases. When a situation or event corresponds to the description contained in one of the 'IF' statements the execution of the second part of the clause is triggered. This relationship mirrors the two main parts of a regulation, which makes it a possible choice for representational purposes and therefore was investigated. Frost considers production rule-based systems as an advance on the record card approach embodied in many DBMS's because they enable more flexible classification techniques. They have been an instrument for developing various aspects of AI because they help to develop sets of rules that can operate through a rule interpreter, in conjunction with a DBMS.[14]

8.3.1 Rule-based systems

The common factor in the techniques referred to above is that they incorporate rules in one form or another and are therefore classified as rule-based systems. Mital and Johnson[15] list the following characteristics of such systems:

- separation of the knowledge base from the inference engine

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13 [Frost86, p.40]

14 ibid.. Frost goes on to add, "a disadvantage of production systems is the lack of formality in the descriptions of them and of the reasoning processes which they use. However, due to the similarity between production rules and the formulae of formal logic, many of the well-defined methods and theorems of formal logic can be applied to production systems." ..... "one advantage of using production rules is the modularity of such an approach compared with procedural representation. In addition they make it possible to catch a useful probabilistic or judgmental knowledge which humans often use in their reasoning."

15 [Mital/Johnson92, p.53]

- use of English-like expressions to improve user interaction
- modularity
- goal-directedness as the mode of inference
- questions seem to follow a logical pattern
- focused reasoning with explanations
- exhaustive search for solutions
- control regime which deals with uncertainties in the strength of association of evidence to hypotheses and the uncertainties regarding the confidence in the existence of the evidence itself.

The problem-solving power in rules comes from the domain-specific knowledge encoded in them. Rules allow inference on the basis of uncertain knowledge, or knowledge which is often, at least initially, ill-specified, features which can be of particular use in relation to the legal status of computer representations.

8.3.2 Production rules for classification

The production rule method is often applied to classification by recognising objects through their distinguishing characteristics. It has also been used to represent regulations descriptively. In their review "Approaches to Representing and Reasoning with Technical or Regulatory Information" [16] Chung and Stone comment on the use of logic programming to create a form of representation somewhere between production rules and conventional frames. An example taken from their commentary is:

```
" min-fire-resistance(E,60) if          % minimum fire resistance of E - 60
                                          minutes
      element-of-structure(E.B),        % E is an element of structure B
```

---

16 [Chung/Stone94, p.153]

```
        building(B),                    % B is a building
        occupancy-sub-group(B,a1),      % occupancy sub-group of B is a1
        separating-wall(E).             % E is a separating wall

min-fire-resistance(E,60) if
        element-of-structure(E,B), building(B),
        occupancy-sub-group(B,a 1),
        height(B,H), H>28.              % height of B is H and H is greater
                                          than 28 meters.
min-fire-resistance(E,60) if
        element-of-structure(E,B), building(B),
        occupancy-sub-group(B, a1),
        compartment-wall(E),            % E is a compartment wall
        height(B,H), H>15.              % height of B is H and H is greater
                                          than 15 meters "
```

This method of representation focuses on identifying both the features required for ensuring compliance and also the characteristics of objects to discover whether they meet the requirements of the regulation. The authors state that:

> "..... although Prolog provides a very convenient representation and a powerful computation mechanism it is not without its problems in practice. Notice that some of the conditions are duplicated a number of times in the rules. This may present two problems. One is consistent updating... the other is slow execution".

They also point out difficulties in the use of the 'not predicate' the interpretation of which in standard Prolog is 'negation as failure' which is not the opposite to a truth condition. However, solutions to this problem are now emerging as extensions to standard Prolog.

8.3.3 Frames in production systems

Frames can store data to support production systems and Frost describes some of their characteristics as follows:

> "In frames, all assertions about a particular entity are held together. Frames are then linked together in frame structures, which represent entity-set membership relations and relations such as the subset relationship between entity-sets. In conceptual dependency structures, all assertions about an action or an event are held together. In scripts, all assertions about a particular sequence of events, such as "going to a restaurant" are also held together."

This dissertation makes use of Prolog programming language to create frames for modelling regulation structure because of their inherently flexible nature. They provide a suitable format for representing regulations, and are also capable of handling inference of generic properties, default values, detection of errors, and omissions in a body of knowledge.

8.4 OTHER OPTIONS

Before finally settling on a frame-based solution, other methods were considered to discover if they held any different possibilities which could be of assistance for portraying the internal make-up of regulations. This exercise was conducted by looking for signs of structure using consumer software to check that simple ways of dividing up regulations could not answer the questions. Finite state transition networks and conceptual dependency methods were found to be less accessible due to the absence of readily available worked examples.

8.4.1 Consumer software

Standard office facilities and simple CAD packages were evaluated to test the following processes:

1) flow-chart diagrams to look for comparative patterns, and establish connections between each part of the regulation.

2) spreadsheet format to record constituent parts and their functional role

3) "syntax crystals" in which the role of words and phrases is represented as a box with relational links that determine permissible connection (functioning in a similar fashion to Unification Based Grammar described later under the heading of Natural Language Processing).

The following conclusions were reached:

	Method	Advantage	Disadvantage
1	Flowchart	clear representation	relationships more than 2 dimensional; so too complex to model except for simple regulations
2	spreadsheet	easy to produce	inflexible
3	syntax crystals	facilitated annotation	complex analysis required in deciding the role of each word

Achieving sufficient subtlety of representation to identify the causes of problems previously identified in leading to disputes in daily use of regulations was the main difficulty. Although it was a simple matter to annotate a diagram by adding pointers between parts of regulations, processing the various structures created into Prolog code required extra simplifications, which lost essential details.

8.4.2 Finite state transition networks

Processing natural language statements has been tried using Prolog in conjunction with networks such as Finite State Transition and Augmented Transition Networks structure. This technique is a way of finding out about elementary parsing constructions using a series of predefined words connected by arcs to determine permitted joins. The interest here lay in the possibility that it might be possible to adopt a similar process to find dependencies within regulations. Tests used arcs taken from a structure that had emerged from the parsing trials described later: intention; context; health; safety; dwellings; etc.

The following example indicates the resulting framework that can be achieved by this process.

```
/*      REGARCS.ARI   Finite State Transition Network   270889 */

        initial(1).
        final(7).
        arc(1,2,int).
        arc(1,2,#).
        arc(2,3,con).
        arc(2,3,#).
        arc(3,4,iv).
        arc(4,5,obj).
        arc(5,6,fea).
        arc(6,7,att).
        arc(7,5,#).

        word(int, health).                  word(int, safety).
        word(con, dwelling).
        word(iv, make).
        word(obj, accommodation).
        word(fea, function).                word(fea, form).
        word(att, adequate).                word(att, foodstore).
```

Pre-processed regulations were satisfactorily parsed. More sophisticated versions of the network were then created requiring larger lexicons, but added little in terms of understanding of the underlying structure. A simple recursive transition network made it possible to obtain a closer match with the original regulation. However, the parsing algorithm was no more sophisticated that the original graphical version. Further tests helped to confirm the role of various constituent parts of a regulation and created the groundwork for a template-like approach. Further investigations tried recursive transition networks and augmented transition networks but these were also found too restrictive for representing regulations.

8.4.3 Conceptual Dependency

It was also thought likely that the work of Schank[Schank84] and his colleagues might have some relevance because their research has looked at very fine detail about the ways in which concepts are built up to describe sequences of events. The use of primitives,

primarily to represent various aspects of actions in an events sequence appeared to offer possibilities for modelling regulations by presenting a method for analysis of statements in fine detail. This looked a promising approach for representing regulations and early stages in this investigation concentrated on the actions defined in *The Building Regulations 1985.*

In writing about conceptual analysis, Sowa has pointed out that the subject is:

> " ..... the work of philosophers, lawyers lexicographers etc.. lawyers do it whenever they draw fine distinctions in arguing a point of law; lexicographers do it in bulk quantities when they compile dictionaries; and systems analysts and database administrators do it when they translate English specifications into a system design." [17]

This view supported the idea that conceptual analysis could play a part in the research.

Conversion of verbs into a short lexicon proved capable of representing all predicates that occur in each clause of the document. This seemed a promising start towards the construction of Prolog predicates with verb equivalents as functors (predicates, or names of relationships). It was hoped that a similar process would generate a set of nouns that could be linked to primitives in a computer program. The primitive would be derived from the set used by Schank to assemble statements equivalent to individual regulations. However, as Shank himself says,[18] his work has focused far less on the problem of representation of the states of objects than the analysis of actions. He then goes on to describe his approach to deal with static situations by using numerical scales from one to ten associated with descriptive words such as health, fear, anger and so on. It was found that this type of comparative scale did not provide enough flexibility to address situations being defined by regulations.

Regulations are primarily aimed at classifying situations and the response required to offset

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17 [Sowa84, p.294]

18 [Schank84, p.44]

potentially undesirable conditions. For this reason, the attempt to break down regulatory stipulations into a relatively small set of primitives using Schank's techniques was considered to be unsuitable for further investigation.

8.5 NATURAL LANGUAGE PROCESSING

Prolog provided an introduction to a range of techniques used in natural language processing. Research on various aspects of artificial intelligence has resulted in steady improvement in natural language processing because of the need for communication between people and machines. These techniques suggest ways of approaching questions of open texture of language, one of the main concerns for legal philosophers in dealing with the analysis of legal statement insofar as it leads to ambiguity and uncertainty. This has made possible more understanding about how ambiguities arise and has suggested ways of removing or disambiguating alternative meanings that might occur.

8.5.1 Aspects of linguistic analysis affecting regulation analysis

Covington's book[19] provides a convenient review of current levels of knowledge in the field of natural language processing and is the background for comments that follow. He discusses five main themes within linguistic analysis, suggesting that each has properties which influence the performance of language in conveying information. They are: morphology; syntax; parsing; semantics; and pragmatics. Each of these has a role to play in analysis of regulations, the precision with which each component can been defined and creates possible areas for misunderstanding.

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19 [Covington94]

For example, morphology shows that inflexion of words (the various forms of each word) makes entry of information into a database uncertain due to the lack of an exact one-to-one correspondence between words which have essentially the same meaning but widely accepted subtle differences in meaning. The derivation of words is also covered by morphology in which new words are built up from old words with subtle changes of meaning. The example given is that of 'dog-catcher' which has acquired overtones of an official.

Covington describes syntax as the lowest level at which language is constantly creative, mentioning that some academics hold the view that the process of parsing sentences to find their internal structure has been largely solved.[20] The significance of the complexities of semantics, for the present research, is that the intended meaning of words is only disambiguated from possible multiple alternatives by checking against context. He refers to Lambda notation used in Prolog as simplifying this process by making explicit the amount of meaning incorporated in a word. Finally he explains that the much less clearly defined subject of pragmatics goes beyond the issue of context, dealing with the means whereby the implication of a sentence is understood as a result of general knowledge. Both semantics and pragmatics are easier subjects to cope with in a restricted domain, a factor that may explain the accumulation of specialist vocabularies in industry and professional areas such as the architecture and the law.

Covington sets out reasons[21] for the use of Prolog for natural language analysis as follows:

- Large complex data structures are easy to build and modify making it easy to represent syntactic and semantic structures, lexical entries and

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20 Covington suggests "semantics is the level at which language makes contact with the real world. This means that semantics is at once the most important part of natural language processing and the most difficult."

21 [Covington88, p12]

the like.

- The program can examine and modify itself allowing use of very abstract programming methods.
- Prolog is designed for knowledge representation and is built around a subset of first order logic so that extensions to this logic are relatively easy to implement.
- A depth first search algorithm is built into Prolog and is easily used in all kinds of parsers. In fact Prolog already has a built-in, ready to use parser.
- Unification (pattern matching) is built into Prolog and can be used to build data structures step by step in such a way that the order of steps does not matter

He comments that Lisp shares only two of these advantages and conventional languages such as Pascal and C lack all of them. He deals at some length with obstacles to interacting successfully with databases, pointing out their reliance on a standard query language (SQL) involving a much-reduced lexicon that accesses rigid data structures. He suggests that phrase structure rules make it is possible to convert sentences quickly into definite clause grammars starting with the facilities built into Prolog. He contrasts this with template or key words systems, such as the 'Eliza' programme, which suggested to early researchers that experiments could generate apparently intelligent conversation from simple word recognition techniques. Much of the work in natural language processing has been built on phrase-structure rules (PS rules). Simple analysis of a sentence into noun phrase and verb phrase can be applied to arrive at a tree-like structure of increasing sophistication recognising case, number, and semantic features. Such a form is a foundation for a parsing programme, which, with the addition of feature labels can be used to carry out the parsing process or generate all acceptable sentences from a set of words. This type of parser is usually described as 'context free' because it can deal with any contextual situation.

8.5.2 Definite-clause grammar

Experiments were carried out using Prolog's definite-clause grammar (DCG) facility to examine information and structure within a regulation, and to assess the relevance of the method. The results were promising, but again required a lexicon to be constructed prior to running the program. Results showed that the technique could be used instead of a front-end menu to give two stages of structural analysis. The parsing module incorporated a simplified version of the regulation that had been developed at that time. Knowledge assumed about regulation structure becomes encoded into the programme in two areas. The first is in the syntax which connects the various sections of the regulation in the following manner:

```
%       A context-free grammar to parse simple regulation 170494
%-------------------------------------------------------------
%       consult this file and try the following query to parse
%       the regulation for grammatical structure:
%       ?- do([if, a, house, safety, then, provide, a, foodstore]).
%-------------------------------------------------------------

        do(X):-         reg(X,[]).
          reg --> sitspec, resdef.
          sitspec-->cntnl, domain, sub-domain, topic.
          resdef--> imp, purpose, entity, constraint.
          cdtnl --> [if].
          imp  --> [then].
          domain--> np, {domain(A,B),asserta(domain(A))}.
          sub-domain--> np, {sub-domain(A,B),asserta(sub-domain(A))}.
          topic --> n.
          purpose --> n.
          entity  --> np.
          constraint  --> vp.
          np  --> det, n.
          vp  --> v, np.

          det --> [the].
          det --> [a].

          n --> [house].
          n --> [safety].
          n --> [store].
          n --> [fridge].
          n --> [food_store].
          v --> [provide].
```

The second way in which knowledge about the body of regulations is built into the programme is that the lexicon must hold all clause numbers and words that are used in the regulations, classified under the relevant parts of speech. For a working system, it would necessary for the parsing section to be improved. Nevertheless, it provided a direct way of testing regulations and simplifies comparison between the original and the pre-processed form. The advantage is that it reduces the difference between the original authorised legal statement and the sequence of words entered into the computer.

Covington describes a further level of sophistication, semantic grammars, as something intermediate between a key word or template system and a phrase-structure grammar. They use phrase-structure rules, but words are classified by their function in a particular situation (such as computer commands or database queries rather than general syntactical principles). Parsing is often preceded by simplification just as in template or key word systems, which have the advantage that their semi-graphical facility for presentation makes it somewhat easier to follow the parsing sequences. The diagrams which can be generated from phrase-structure analysis assist in making underlying ambiguities explicit, by showing how more than one meaning can be expressed. Examples of these were tried on regulations in the early stages of the investigation.

Covington demonstrates that the basic structure of determinant and noun can be expanded by the addition of adjectives and adjectival phrases. This may be followed by a prepositional phrase, which may also be an internal sentence. However, he points out that phrase-structure rules fail by being unable to express adverbs because of the many possible positions they can take within a sentence. Transformation grammar was introduced to improve on phrase-structure methods and accounted for many grammatical regularities such as agreement, case marking, dealing with the passive sense etc. He puts forward the view that nowadays most of these early developments have been subsumed by unification-based grammar (UBG).

His work provided insight into methods needed to add qualifiers into the frames required by the final template used to express the internal structure of regulations.

8.5.3 Parsing refinements

Using a sample grammar:

S-	NP VP
VP-	V(NP)
NP-	Pronoun
NP-	DN
Pronoun-	he, him, it, they, them
D-	the, a, two
N-	dog, dogs, cat, cats
V-	bark, barks, scare, scares

Covington builds a foundation for a working grammar using Prolog recognising five constraints:

* Number agreement of subject and verb;
* Number agreement of determiner and noun;
* Assignment of nominative case to subject;
* Assignment of accusative case to object
* Subcategorization to distinguish verbs to do and do not take objects.

This results in an extension of Prolog, which Covington calls GULP in which both conventional and equational styles can be used. He gives examples of two ways of writing rules in GULP:

```
s --- np(pers:P..num:X..case:nom), vp(pers:P..num:X).
s --- np(NPfeatures), vp(VPfeatures),
        { NPfeatures = pers:P,  VPfeatures = pers:P,
          NPfeatures = num:X,  VPfeatures = num:X,
          NPfeatures = case:nom }.
```

This method of representation underlines the complexity of maintaining agreement to be capable of dealing with all types of features through the unification process[22]

---

22 "Today, however, the leading view is that all features can be accounted for by just one operation - unification -

8.6.1 Initial strategy for representation of regulations

It had been originally intended to provide a parsing interface between the Prolog program and the user. There were two aims: firstly to use the underlying structure to confirm the existence of the internal structure; and secondly to enable the user to enter regulations with a minimum of pre-processing. Numerous attempts with this approach resulted in little progress. This is explained by Covington's observations on the limitations of current parsing techniques:

1. top down - uses recursive descent and loops on left recursive statements such as A - AB, which because this is a very common structure is a serious deficiency.
2. bottom up - deals with the problem of left recursive loops but cannot handle situations where the determiner is absent
3. left corner parsing - a combination of top down and bottom up.
4. chart parsing - a technique to reduce wasted processing time in investigating the same structure over repeatedly when backing up the parsing tree.
5. Earley's algorithm designed to combine the benefits of top down and bottom up parsing together with storage of work in progress to avoid unnecessary backtracking.[23]

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which applies along with each phrase-structure rule."[ibid. p.114]

23 [ibid. p.191/2]

The attraction of using a form of parsing to detect internal structure within regulations is that it supports investigation of aspects of linguistic analysis in great detail. Through the regeneration of statements it possible to confirm whether the exact structure has been accurately captured. Unfortunately, even on high-speed equipment the more advanced processes take a substantial amount of time to deal with moderately complicated statements.[24]

These techniques draw out fine distinctions contained in apparently simple sentences such as "three boys bought five apples". It seems, however, that when sentences become complicated, as for example the convoluted multi-clause approach used by most regulations, parsing has to be limited to experimental investigations.

8.6.2 Predicates

The Statutory Instrument[25] that is the source of the regulations is relatively short, 26 pages, and is elaborated by relevant sections of the Approved Documents that describe acceptable forms of construction. It was therefore, a relatively simple matter to extract all the verbs from the Statutory Instrument and reduce these to a list of predicates that can stand in for words with a sufficiently similar meaning. For example the word 'equal' can be used to stand for 'cite, deem, mean, meet, regard and treat'. This work had two aims, to attempt to relate verbs used to the primitives proposed by Schank to represent all 'ACTS', and to establish the range of the activities to be covered by computer representation.

However, it emerged during subsequent investigation that verbs contribute little to

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24 Covington says "The sad news is that as algorithms get better the parsing gets slower and slower. Down parsing is very fast; left corner parsing is second best; but shift reduced parsing and all the chart parsers are regrettably slow, to the point that Earley's algorithm with subsumption is intolerable."

25 STATUTORY INSTRUMENT 1985 No 1065 "The Building Regulations 1985"

regulation structure. Regulations are descriptions of state, and boundaries of that state. For this reason verbs have less importance than nouns and qualifiers as will be seen from the final structure proposed.

8.6.3 Nouns

A similar review of the nouns used within the regulations was attempted without success. The Building Regulations have a section[26] dealing with interpretation, which gives meanings for particular words. For example 'dwelling' includes a dwelling house and a flat, whereas, a 'dwelling house' does not include a flat or a building containing a flat. Major difficulties[27] were encountered in trying to build-up a sub-set lexicon of nouns that could stand for a series of other nouns in the same way as had been done for verbs. Words such as 'wall', 'bathroom', 'sanitary convenience' etc., are used consistently but because of industry conventions are generalizations that have become entrenched. They have acquired a range of specialised meanings introducing difficulties that arise from the open texture of language when applied in a wider context than the construction industry.

8.6.4 Manual parsing

Building Regulation G1[28] states:

> "There shall be adequate accommodation for the storage of food or adequate space for the provision of such accommodation by the occupier."

This is, in effect, two alternative stipulations by the regulation.

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26 Part I: GENERAL Interpretation 2.-(1-6)

27 These problems largely stem from the control of a noun's meaning by other parts of the sentence in which it is located.

28 *The Building Regulations 1985* p4.

The first part can be analysed using existing conventions for sentence analysis based on examples given in a standard textbook[29] as follows:

Subject	-	there	(adverb)
Predicate	-	shall be	(verb phrase, modular auxiliary plus copula)
Direct Object		adequate	(adjective)
		accommodation	(head noun)
		for	(object attribute adverb phrase preposition)
		the	(noun phrase determiner)
		storage	(noun)
		of	(preposition)
		food	(noun)

This reveals the complex nature of what is, in effect, a very simple part of an example regulation. It emphasises the degree of sophistication that would be required from a parsing programme to handle subordinate clauses and embedded sentences.

8.6.5 Graphical parsing

A Prolog parsing programme with graphical output was used to generate a series of representations of regulations in Section G of the Building Regulations, as a basis for comparison. The same process was carried out twice more to examine aspects of relationships between the various parts of each regulation.

The first stage provided an overview of the most obvious aspects of a regulation's structural makeup using Backus-Naur syntax in conjunction with Prolog's DCG.

The second stage tested a range of meanings for various keywords to examine contextual relationships.

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29 [Aarts82]

The third level of investigation repeated the previous experiments and in addition looked for connections between words and the external associations used in a pragmatic sense to provide further qualification to enrich their meaning. For example, 'store' is further qualified by the Approved Documents in terms of, size, height, ventilation, and accessibility.

The results of each cycle suggested further questions for generating the next series of graphs. This can be seen from the obvious gaps in the following example dealing with regulation G1[30] which required the provision of a food store.

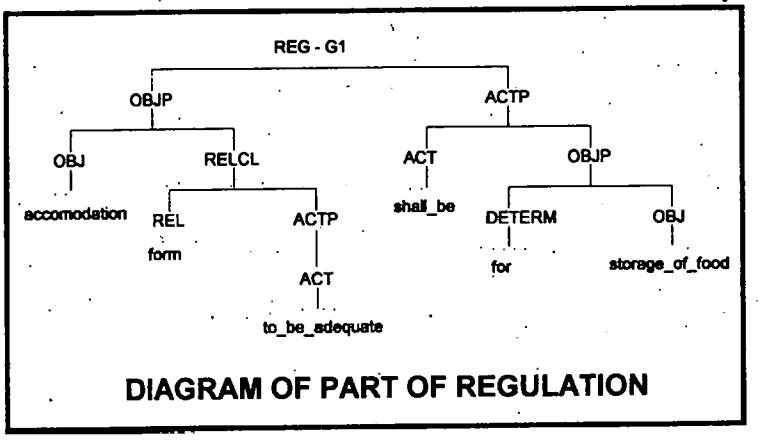

FIGURE 8.1

8.6.6 First stage - an outline structure

The Prolog programme accepts a series of words that have previously been entered into a lexical database. Output is produced in the form of a tree with branch headings classified as object phrase, verb phrase, determinant, object, relative pronoun, adjective, verb, etc. By modifying the headings output was generated which more closely represented the

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30 food storage G1

"There shall be adequate accommodation for the storage of food or adequate space for the provision of such accommodation by the occupier."

format of the regulation as the following example[31] shows:

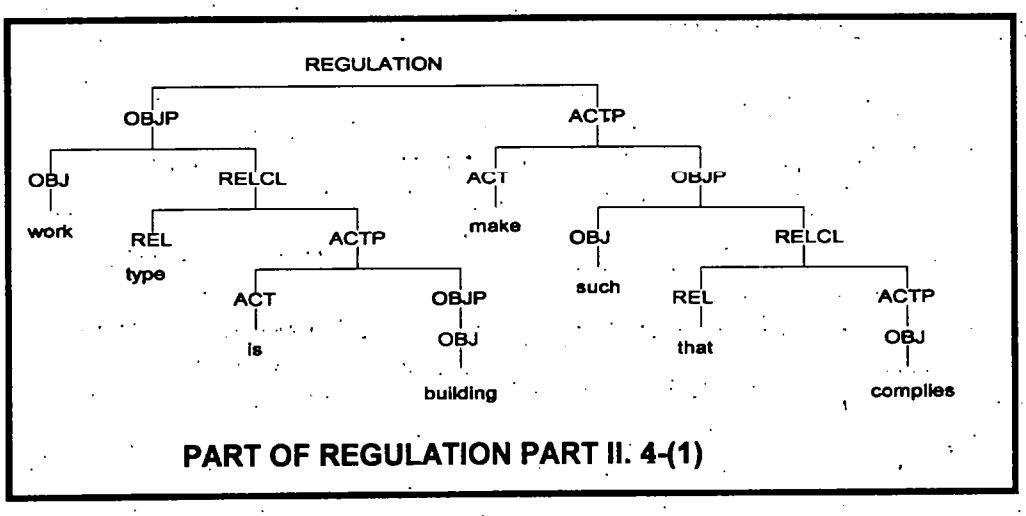

FIGURE 8.2

The limited nature of the parsing algorithm made it necessary to create a version of each regulation, which greatly distorted the original text. Nevertheless the comparison was usually sufficiently close to draw attention to important boundaries between various sections of the regulation and suggest how particular words or phrases influenced the eventual meaning.

8.6.7 Second stage

For the next cycle, significant words within the original were marked to improve the relationship between the original regulations and the graphs. Each was then checked to score the occurrence of these words. This gave some indication of the extent to which the original had been represented. For example, in representing G2 the first pass scored 4/14 and by careful adjustment this was increased to 6. The low proportion is partly as a result

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31 Part II: CONTROL OF BUILDING WORK Requirements relating to building work

4. (1) Building work shall be carried out so that (a) it complies with the relevant requirements contained in Schedules 1 and 2, ...

of the crude parsing process and also an inappropriate structure embedded in the grammar of the parser programme used.

Regulation G3 states:

> "if hot water is stored and the storage system does not incorporate a vent pipe to the atmosphere, there shall be adequate precautions to:
>
> a) prevent the temperature of the stored water at any time exceeding 100 deg. C; and
>
> b) ensure that the hot water discharged from safety devices is safely conveyed to where it is visible but will cause no danger to persons in or about the building."

The two parts of the regulation are complementary and therefore both have to be accounted for in the parsing process. This is a much more complex regulation from a representation point of view, requiring two separate attempts at creating an initial representation with a highest score achieved of 3/22. Lack of an extended vocabulary restricted the representation and involved convoluted use of the lexicon in order to achieve any sort of match with the original. It was noticeable that the different texture of the regulation created extra problems, despite the fact that the first part (a) is quite explicit. The second part (b) is much harder to portray because it uses phrases such as "safely conveyed" and "visible but will cause no danger". The final regulation being examined, G4, proved much easier at the first attempt and produced a score of 6/20 when phrases such as "so as to" were omitted.

8.6.8 Third stage

The third stage of analysis looked at degrees of precision using a simple estimate of the use of each word. By comparing the dictionary definition with the use of the word in the regulation an assessment was made of the relative vagueness or ambiguity of certain keywords. For example, in the case of the regulation dealing with food storage accommodation, it was estimated that the word "accommodation" had a degree of precision of 50%, whereas the associated phrase "for all dwellings" was substantially less, at around 20%. The phrase "to be adequate" is so general as to be of little guidance when

attempting to define exact boundaries of constraints in regulation documents.

8.6.9 Summary comments on Section G

Section G of *The Building Regulations 1985* comes under the heading "Hygiene". The drafters of the regulation connected this set of regulations with either, maintaining provision of hygienic conditions, or controlling the way in which these conditions are met. An example would be the provision of safety limits in connection with the supply of hot water. Some indication of the purpose of the regulation is included in accompanying explanatory remarks to each regulation and points to the general context in which each regulation is to be interpreted. Comparison with the first stage analysis of this regulation shows that the first draft did not closely follow the form of the regulation. Furthermore the subject was modified in a way which is not intended in the regulation. By making changes to the parsing structure it was possible to achieve improved scores for the occurrence of original words from the regulation, the best example of which based on G1 produced a score of 8/11 as follows:

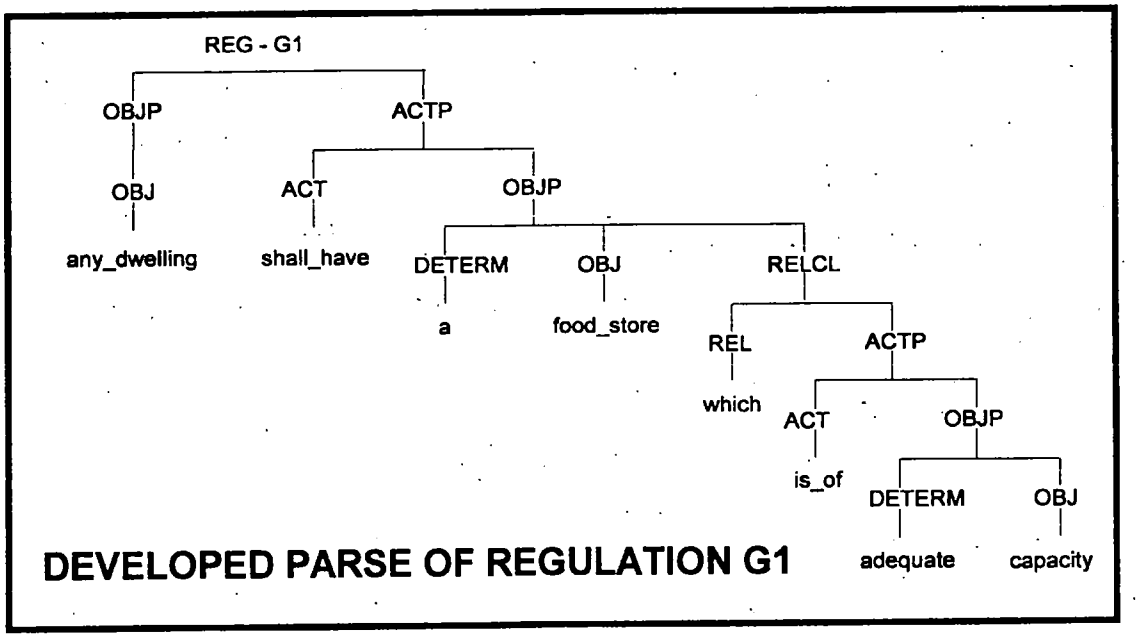

FIGURE 8.3

8.6.10 Pre-processing

The process of analysis at this stage consisted of establishing the main constituents of each regulation and classifying them in terms of function. This was done as a 'manual' process in view of the subtle issues raised and the need to rely on industry knowledge to obtain a realistic appraisal of the contents of the regulation. Confirming sentence pattern, identifying categories by which the functional constituents are realised, and the structure of the main constituents followed this. Finally the immediate components of the functional constituents were described to help analyse the lower levels of the sentence. This pre-processing was necessary due to the very basic structure in the parsing grammar and the limited vocabulary included to support the parsing process.

8.6.11 Obstacles to the use of parsing

The relatively crude graphical parsing program was useful during the initial process of finding out about the general internal structure of building regulations. However, the complications described in section 8.6.1 made it clear that to achieve an acceptable degree of subtlety in processing the multi-clause nature of regulations would not be possible without substantial additional programming skills unrelated to the focus of the dissertation.

In addition to the procedural difficulties defined above there are also issues arising out of open texture of language and subtle change of meaning of words, even within a relatively closed discipline like the construction industry. It became evident that tracking the change of meaning for a word like 'maisonette' would be more straightforward through the use of frame structures using the process of inheritance. A cross-reference can be added by this technique pointing to a new interpretation when necessary, through the context segment described in the next chapter.

It was therefore decided to explore frame formats for representing regulations in more detail.

8.7 FRAMES

8.7.1 Frames in general

The advantages of employing relatively simple frame systems to capture the internal structure of regulations became evident after assessing various ways of putting together data structures. Frames address the problem that in formal logic languages there are no facilities for clustering statements about individual entities or aspects of the domain of discourse. Among the earlier schemes for representation of language are semantic networks. These were devised for cognitive psychological research, as an intermediate language for machine translation, as a way of representing statements in which concepts are tied together. Frame-based systems were developed initially as pattern recognition sub-systems of natural language understanding systems.

Semantic networks like other slot and filler schemes introduce a structure that is absent in formal logic. Frost describes a semantic net as "a directed graph in which nodes represent entities and arcs represent binary relationships between them. Arcs are labelled with the names of the relationship type, i.e. the binary relation to which the relationship belongs. A single entity is represented by a single node."[32] Frames on the other hand deal with aspects of a single entity or situation and are a form of extended semantic net. Like the case-frames of Case Grammar and Conceptual Dependency, frames have a slot and filler structure. In frames, however, the links between slots need not be the labels of some grammatical category or some conceptual primitives; they are higher order links, which facilitate complex interlinking of frames. In other words, frames are an outline of a general

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[32] [Frost86, p.457].

structure adequate to represent collections of attributes of objects, locations, situations, processes, etc., which support structured knowledge representation.

8.7.2 Inferences

Frost describes three main types of deductive inferences that can be made using frames:[33]

> a) When a 'sufficient match' is made, the system can infer the existence of an entity of the entity type represented by the frame. For example, if a match is made between the values known for the properties of an entity and the values required to fill the slots of the 'family man' frame, then the system can assume that a family man exists.
>
> b) When a sufficient match is made, we can infer that the entity represented by the instantiation has the generic values. For example, we can infer that a family man has marital status 'married'. Generic properties of one entity type are passed down as generic properties of sub-sets of this type.
>
> c) If the system has been told that 'person Bill is like a bulldozer', it can use analogical inference to deduce values for various properties of Bill. For example, if both person and vehicle frames have slots for weight, and the bulldozer's instantiation of the vehicle frame has a relatively high value in this slot - we can put a relatively high value in the weight slot of the person frame when we instantiate it to represent Bill.

8.7.3 Inheritance, defaults and demons

One of the major features of frames is their ability to inherit information. Information can be transferred from a generic entity so that only the exceptions need to be recorded where entities have significant similarities between members of a class of similar objects. A simple example is that of birds which: fly; have two legs; and wings. This information can be transferred to an ostrich with the information that it is not capable of flight. This greatly reduces the amount of information that needs to be stored and makes taxonomic relationships easier to comprehend.

In a similar fashion, to the transfer of inherited data information, default data can be

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[33] [Frost88, p.466]

collected from a generic example as in the previous case, where information about the number of legs of a bird can be default information. This simplifies building up data about groups of similar objects. Demon is a general term for procedural slots activated when data is added to a system that stores variables for calculation purposes. It also a term to describe the message passing process used to obtain further information from a user, or other parts of the database.

8.7.4 Disadvantages

The main shortcomings experienced with the use of frames in the final program were:

1) A substantial amount of pre-processing is still necessary,
2) the user interface works on a question and answer routine requiring the user to enter single words or series of linked words rather than communicating through any form of parsing,
3) tracing the reasoning can be difficult when faults arise,
4) direct comparison between regulation structures has not been incorporated.

8.7.5 Advantages

The four advantages of frames are:

1. the ability to represent information about discrete parts of an entity
2. facilities for inheritance
3. the use of default information and
4. incorporating procedural attachments known as demons.

Frames can be kept quite brief if the knowledge requirements are narrow in scope. They are straightforward to update so that the length of the information recorded about an entity can change or be extended in the future.

The generality and power of frames comes from the fact that the slots can be assigned the role of *facets* with pre-determined functions:

VALUES:

specification of permitted fillers or conditions to be met for any filler of the slot; e.g. the slot 'employed_status' may have a value facet of the form:

'*one of* employed, self-employed, unemployed, retired,...'

DEFAULTS:

filler value to be assumed in the absence of any evidence to the effect that another value is appropriate.

PROCEDURES (slots with procedural facts are sometimes call demons):

* To-establish procedures: to specify how to compute a slot value.
* If-added procedures: to specify what to do when the slot is filled.
* If-accessed procedures: what to do when an enquiry is about the value of the slot.

8.7.6 Benefits from using frame based methods

The combination of these features of frames makes them direct in use, relatively easy to interpret by examination of the code and easy to set up and program. Unfortunately one drawback is that in execution the number of inter-related links can lead to a complicated transfer of information within the system. This makes the sequence of operations hard to follow and demands a careful display of information for understanding. They are well suited for demonstrating relationship of ideas. A front-end is usually provided where systems have been fully worked out. This makes the operation of the system transparent to the user but restricts the domain of application fairly rigorously to obtain useful results.

The decision to proceed with a frame-based form of representation took into account apparent progress in each field at the time of commencing the research. The decision also recognised apparent potential for further development. Furthermore, the Prolog language

appears to create the most concise code and has the advantage that the programme statements are closely similar to natural language statements.

8.8 EXAMPLES OF FRAMES IN PROLOG

8.8.1 Frame and data structure

A frame-based approach was adopted to experiment directly with data structures with the fewest possible restrictions arising out of the particular requirements of the programming methods. A balance was required between the simplicity obtainable from a binary form and greater sophistication capable of holding subtler distinctions but needing more effort to maintain rigorously. Inevitably the chosen structure influenced the possible manipulations of data, general readability and the form of the inference engine.

The flexibility of the frame-based approach makes possible a wide range of arrangements for tackling different situations. Examples follow of types of frame structure being used for Prolog representation of knowledge. The examples that illustrate the significance of some of these differences are:

- frame/1 single list of attributes
- frame/2 frame name and list of attributes
- frame/2 named predicate with two arguments
- frame/3 frame name, slot name and list of slot values
- frame/4 frame name, slot name, facet name and slot value

The number after the word 'frame' gives the number of arguments and thus the complexity of the unit of data. This defines the slot structure and requires matching procedures for handling input, output and queries. The part of the program, which operates on the given

data, can be constructed to vary the level of detail made available. However, the greater the subtlety within each data unit the greater the information which can be extracted.

8.8.2 Examples of type of frame arrangements

Examples of applying each format to regulation representation are:

8.8.2.1 frame/1

A single list containing several components:

```
frame(SlotList).
frame([Reg,Domain,SubDomain,Topic,Purpose,Entity,Feature,
                                                Constraint]).
```

A single list it is rather inflexible. Since it imposes no structure on the organisation of the regulation being analysed, this arrangement gives no opportunity to test out ideas about a possible internal structure within regulations.

8.8.2.2 frame/2

A named argument, the frame name, followed by a list of values for each slot:

```
frame(Name,Slotlist).
frame(Reg,[
Domain,SubDomain,Topic,Purpose,Entity,Feature,Constraint]).
```

Inserting the frame name at the beginning makes identification easier and the database somewhat simpler to understand.

8.8.2.3 frame/2

The frame identifier as functor with 2 arguments for each slot:

```
name(Value1,Value2)
Regulation(Description,Component).
```

This version of a frame is given by Bratko using the frame or object name as label for each slot and type of slot having two arguments[34]. The first value is a qualifier of the second, as in bird(moving_method,fly) This uses a system predicate 'univ' (=..) to handle retrieval of

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34 [Bratko90, p350]

information. This presents some difficulties when trying to assert new clauses into the database because Prolog will not accept the 'univ' operator in a clause dealing with assertion. This illustrates how program limitations restrict expression of a clause.

8.8.2.4 frame/3

An identifier and slotname followed by list of slot values:

```
frame(Object,Facet,DataList)
frame(Reg,Domain,[Value1,Value2,.....]).
```

This arrangement could be used to provide separate descriptive characteristics to each component of a regulation. Inheritance is simple to organise both up and down the hierarchy through the second argument by means of "ako" or similar predicates. The example shows the structure being used in conjunction with a wider arity range of predicates in the form of a semantic net. The format used here shows the frame structure can be very flexible.

8.8.2.5 frame/4

Slotname, object, and facet arguments followed by list of slot values:

```
frame(Name,Object,Facet,ValueList)
frame(Reg,Entity,Facet,[Value1,Value2,.....]).
```

This is a direct approach to creating frames through the name of the slot - all those with the same name are thus linked together and can inherit up and down through the facet slot. This makes the choice of object names free of restrictions and the slot or facet arguments can be used for searching. Most of the slot are of the 'value' type but it is through this argument that procedures are called. The addition of a facet value assists processing and provides for inclusion of demons for extra control such as calculating values or obtaining user input.

It will be realised that each method may be more suitable than others for a particular applications. Because each application is different a large variety of ways of expressing information through frames has been developed. The result of this variety is that

interchange of information between systems is almost impossible without intermediate translators. Nevertheless, the advantages of frame-based representation outweigh the disadvantages as an experimental tool. Each of the alternative arrangements influence the subtlety of regulation structure that it is possible to express so that results obtained depend to varying amounts on the form chosen. Each was tried in turn in an attempt to obtain the most neutral organisation of data capable of representing the complexity needed to capture enough detail for modelling disputes.

8.9 SPECIFICATION FOR REGULATION FRAME-BASED PROCESSOR

8.9.1 Required functions

Essential features emerged from experiments with various configurations as necessary for adequate representation of regulations to reveal their underlying structure. These are:

1. storage in a consistent format to facilitate comparison and querying the database,
2. separate identification of each clause or part clause fixing discrete limits,
3. capacity for inheritance,
4. represent segments of regulations and their components
5. expose constraint mechanism with different levels of complexity
6. facilities for recording features of generalizations, entrenchment and over- or under-inclusiveness
7. variable number of slots within each frame to handle varying amounts of qualification.

In addition there are optional facilities which could be included for adding, modifying, and querying the database on the fly. This aspect of the program is for ease of working and

largely independent of the structure being manipulated. In an experimental sense, the use of frames is an approach similar to taking notes.

Prolog makes it possible for additional slots to be added and alternative ways of expressing regulations tried out to assess their implications. The programming language helps this process because it is relatively easy to devise test queries as work proceeds. The application of this technique to representation of regulations in computer processible format is described in the next chapter.

The final program has to provide a reusable framework to reflect the make-up of *The Building Regulations 1985* whilst making available the features of the language which support direct interaction. The program must add linking code to words entered by the operator and ensure that the right connections are made so that it becomes possible to extract correct information. It will function as a checklist by systematically leading the operator through the large number of questions needed to analyse a regulation clause in depth.

The related frames should connect together to create a template which adequately represents each of the regulatory statements contained in *The Building Regulations 1985*.

8.9.2 Prototype frame

The initial frame format and inference engine were taken from an example given by Merritt.[35] The advantages of the selected frame format are:

1 values can be represented either as single valued or multi valued. Single values are represented by terms, multiple values are stored in lists.

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35 [Merrit89, p. 99]

2 A frame may have multiple values in the "AKO" slot, allowing for a more complex structure than a straightforward hierarchy.

3 default values and procedural slots are represented in a simple and direct fashion.

An enhancement would be for the program to ask questions regarding experiential information about the use of the regulation in practice and any related case law and in so doing would accumulate historical knowledge.

8.9.3 The schema behind the template

Each cycle of analysis of selected regulations led to further refinements to the form of the template envisage depicting their internal structure.

The regulation B1, which had been found to be responsible for most of the disputes, introduced several changes before acceptable representations could be produced for the many 'threads' it contains.

The most important extension required was when it became evident that a 'segment frame' is needed to cater for contextual issues. The generally accepted division of a prescriptive rule into two parts does not provide for contextual influences which affect both the other parts of a regulation. The inclusion of a class of frame to hold context references, additional to those for the situational specification and response definition, resolves this issue.

Frames to hold details of generalizations, entrenchments, and inclusiveness qualifiers are also necessary. Some elements of regulations were found to require varying numbers of qualifiers and the program must have the capacity to manage frames with varying numbers of slots.

The encompassing template, which is illustrated in the next chapter, incorporates three classes of frames. The first identifies the regulation being analysed by recording the clause number and is followed by a list contain three slots. The values of the slots hold the names of the segment class of frames that contain information about context, situational specification, and response definition. Each of these frames has slots holding the values of the components forming the respective segment. The third level of frame contains the information that qualifies components and can be of any length.

8.9.4 Evaluation

Trials of the programme to analyse regulation examples found that:

1. the program captured most of the work on regulation structure done to date,
2. the slots structure embodies adequately, the sub-divisions of the selected regulations and can represent the main characteristics of disputes,
3. the supporting utilities show the contents of the database as individual slots, frames or display the whole of the data associated with a regulation in a suitable form for further evaluation.

The next chapter describes the application of the developed frame-based representation to selected examples taken from *The Building Regulations 1985.*

CHAPTER 9 REGULATIONS IN FRAME BASED FORMAT

Abstract

This chapter presents the proposition that building regulations have an internal structure that is consistent and independent of language form. The internal structure is revealed through a sequence of interconnected Prolog frames. These are combined to form the encompassing template that relates to the subject area of the building regulations. The frame structure, from which regulations are constructed, and the process of analysis are described.

It is claimed that this is true for all clauses of The Building Regulations 1985 and that it provides a useful way of viewing regulations.

Investigations are described showing that the template is applicable to a sample set of building regulations. The process of analysing regulations in this way provides a way both of focusing more sharply on the exact source of disputes. In addition regulations can be found where certain elements of one regulation are repeated in others and the type of constraint is confirmed.

The process of analysis is described. Reference is made to Appendix A, which gives several worked examples of representations of disputes, and to Appendix C, which provides samples of output from an analysis session.

9.1 INTRODUCTION

This chapter presents a model[1] of the internal structure of building regulations designed to account for issues raised earlier in this dissertation. Ideas about the working of rules in general have been reviewed by looking at the work of Schauer who has set out pertinent characteristics of prescriptive rules. This provided the background to the examination of the building regulations in the context of general systems theory to identify the main features to be looked for when analysing building regulations.

Features influencing each part of *The Building Regulations 1985* have been examined to understand how they function and to determine those aspects that need to be present in an alternative representation. The comparison of the UK version of regulations, for control of building construction, with those from other European countries suggested that differences in style and objectives might have a bearing on the possible existence of any common underlying structure.

The justification for the results of the investigation depend heavily on the documented disputes available for comparison. Considering the nature and causes of such disputes played an important part in establishing which elements of regulations carry out discrete roles in their operation. The previous chapter described a series of attempts to deal with questions of internal structure using a range of techniques giving details of limitations encountered with each. This chapter presents the arguments to support the theory that building regulations in the UK. have a consistent internal structure common to all examples, based on results obtained by thorough examination of certain key examples using Prolog routines.

We have seen that research already carried out into the representation of regulations in Prolog has established the language as a suitable tool for further investigation of regulatory structure. There are benefits to be obtained from using it as a tool aid when experimenting with various forms of regulation. These benefits are described, together with an explanation of how certain aspects of the Prolog program have influenced the results. In particular the process of modelling and query inheritance available within frame structures is shown to have simplified the trial and error techniques used to arrive at the final

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[1] By 'modelling' we mean, in this context, the process of representing the internal structure of regulations in frame-based format. The set of frames which embody the internal structure is referred to as the 'template' for *The Building Regulations 1985*.

representation. Suggestions are offered as to how the modelling process can be sharpened further to obtain future improvements.

An explanation of the way in which Prolog is used to transfer a particular regulation into a database for querying and comparison is then given. The process of analysis is described using a detailed example to explain the method used. The sample regulation is analysed fully in the context of a dispute to illustrate how these ideas are applied in practice. This example also shows how repeated comparison with a range of documented appeals and determinations has supported the refinement of the model.

The chapter concludes with a discussion of possibilities for testing the theory, and the limitations associated with the method of analysis used.

9.2 THE THEORY

The proposition is that the building regulations have an internal structure, which is uniform across all the regulations and independent of the form of language used to express them[2]. The implication of the notion of an internal structure offers the possibility of detailed comparison between similar elements of regulations. What appeared to be glaring inconsistencies between interpretation of simple clauses had been observed in architectural practice. Experience has suggested that problems tended to fall into similar categories but detailed comparison of variations in the application of regulations was not possible without a method for systematic analysis.

For the purposes of this dissertation certain terms have been given specific meanings to clarify the explanation of the theory. The form taken by the internal structure of a single regulation is described as a 'template', which is made up from a series of Prolog 'frames'. Each frame is made up from two or more data slots serving a pre-determined purpose. The frames forming the template are held together by named slots which bring together those frames which make up an instance of an individual regulation.

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2 The theory is confined to *The Building Regulations 1985* edition, although it is possible that the structural form may apply equally to other similar bodies of prescriptive rules - especially if the body of regulations has the same kind of environment, provides clearly stated constraints, and operates within much the same compliance process.

Each of the frames comprising a regulation follow the same pattern but perform one of three different roles within the template. The main parts of a regulation are termed 'segment frames' and are composed of two or more 'component frames'. Additional attributes are attached to the components by 'qualifier frames'.

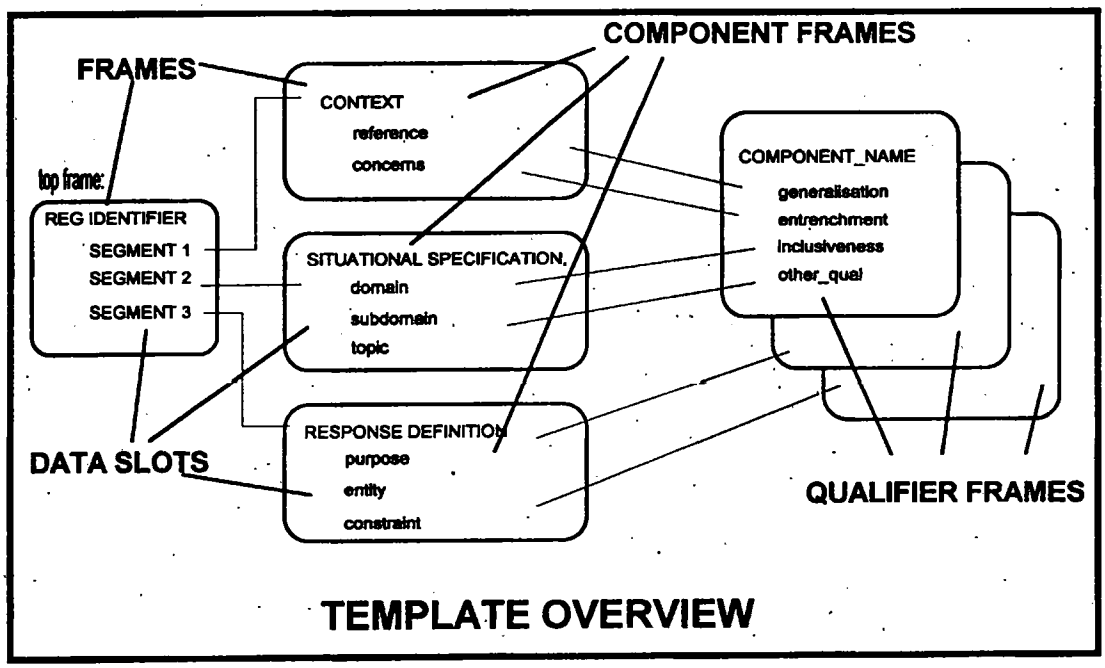

FIGURE 9.1

Figure 9.1 shows the relationship between the elements that make up the template of regulations within *The Building Regulations 1985*.

Regulations within *The Building Regulations 1985* are collected together in sections relating to different aspects of building works. It is important to stress that, for the purposes of analysis, the term 'regulation' is applied to a single statement laying down limits for acceptable construction. In this sense the regulation may be one of a number of threads within a regulatory clause, each of which defines boundaries for compliance.

9.3 CLAIMS

Two claims are made for the template which it is proposed in this thesis as embodying the internal structure of regulations: that it is true for all instances within *The Building Regulations 1985*; and that it provides a useful way of looking at regulations.

9.3.1 That it is true for all clauses

The assertion that the template can be used to reflect the legislative content of all examples from the selected body of regulations is based on repetitive analysis of representative samples taken from several sections from *The Building Regulations 1985*. Examples from each of the principle groups analysed are given in Appendix A, including some of the results illustrating disputes.

Initial attempts at simple alternative forms of the regulations focussed on the 'Hygiene' section of *The Building Regulations 1985* to simplify direct comparison between alternative methods. This section was used for the bulk of the investigation to compare results obtained from the different techniques being assessed. Once a workable prototype program had been developed the investigation was extended to cover regulations from other sections of *The Building Regulations 1985*.

The final process produces consistent results using the Prolog program. No examples have been found from the requirements of the Building Regulations that cannot be satisfactorily converted into the template format created by the program. This suggests that the template can form the basis of a general and more developed process for the drafting and analysis of building regulations.

9.3.2 That it is a useful way for looking at regulations

The most beneficial aspect of modelling regulations in this way is that it exposes gaps and inconsistencies. It can also be used as an aid to drafting or handling questions of interpretation. In addition, breaking a regulation into elements can improve understanding about the underlying justification behind it and the role of each component.

The building regulations are an example of regulations that require persons to obtain approval prior to carrying out their intentions. Increasingly in the UK the emphasis of regulation is shifting towards legislation which expects compliance as a result of regulations being implemented by Parliament[3]. Controlling authorities are expected to concentrate on prosecuting in cases of abuse rather than on giving approval to individual proposals. This transfers the onus outwards from the regulatory body towards individuals or organisations who may lack the training or experience needed to make proper provision

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3 The Construction Design and Management Regulations 1984 are an example of this trend.

for the detailed obligations imposed by a fairly complex network of clauses. Exposing gaps or overlaps when regulations are being drafted is a particular benefit in preventing unnecessary ambiguities or misunderstanding.

When it comes to the application of the regulation, especially for new regulations, the advantage of having a consistent method for analysis is obvious. Training those who will be expected to detect non-compliance and enabling persons seeking to comply are two aspects of this issue.

What has emerged unexpectedly from this research is that one component of a regulation always contains the executive element that controls the effect of the regulation. This vital element is the constraint mechanism, about which more will be said at the end of this chapter. From the point of view of the building regulations the principal distinguishing feature of the constraint mechanism is that it normally contains quantitative limits and as such is easy to recognise. For example, it can also be extracted and used to drive a rule-based system in CAD software.

As an illustration, it is possible to obtain a list of all regulations that have only an upper bound in the constraint mechanism. The inheritance process locates not only the regulations, which have the specified domain, but also those from which the domain value is inherited. This provides a simple and quick means of testing the database by making direct queries possible direct queries without requiring new code to be compiled. These tests can be stored for later reuse if they are found to yield interesting results for, as an guide, reviewing them as part of the general family of normative prescriptions.

The template proposed to encapsulate the internal structure of *The Building Regulations 1985* represents only that particular set of regulations. For clarity the template omits a higher level frame, which would be required in a wider study of regulations, to link each regulation to the enabling legislation from which it stems and to separate each set of regulations from others.

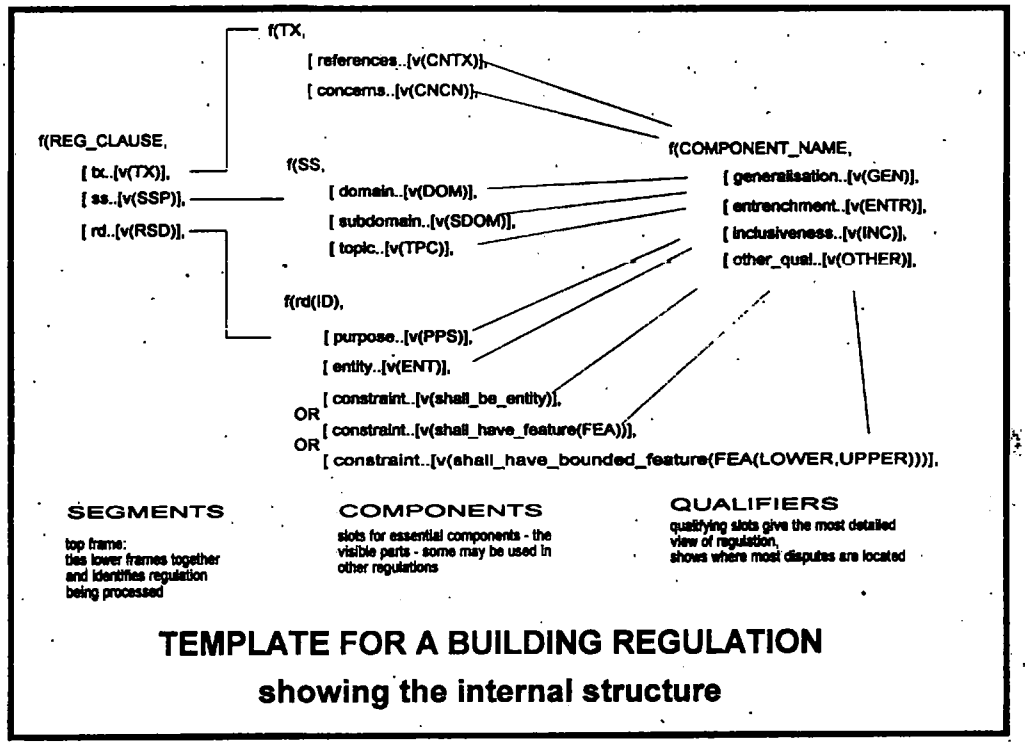

FIGURE 9.2

9.4.1 Overview of the internal structure

The main features of the internal structure of the regulation are classified in the template as 'segments', 'components', or 'qualifiers'. The data about each are stored in a series of Prolog frames or inherited from previously stored regulations with an identical characteristic.

'Segments frames' are the highest level of frame, collecting together the regulation identifier and the names of the segments which make up the whole regulation. The 'components frames' are the second level comprising: context; situational specification; and response definition. Component frames contain, in the main, words that have been used to express the regulation in its original form but sometimes need additions or substitutions to make the meaning clearer. Some components are inferred from notes attached to the regulation

or from the section heading. At the lowest level are 'qualifier frames' storing a generalisation for each of the components and additional attributes if required.

The next section of this chapter describes the segments in general terms. The specific components that make up each segment are then expanded upon in the following sections. Finally, the operation of the qualifiers is explained.

9.4.2 The segments of a regulation

The top-level frame has three data slots bringing together the names of the main parts of the regulation. It conveys no information apart from recording how the segments are linked together. Each slot contains as its value the name of the subordinate frame that holds a section of the most direct representation of the regulation.

9.4.2.1 context

In addition to the two parts of a regulation identified in chapter 3; the 'situational specification' and 'response definition', it was found that there is a need to hold certain contextual information. The 'context segment' is a frame with two slots; 'references' and 'concerns'. The need for the first of these arose when it became apparent that data about reference documentation mentioned in Approved Documents or associated legislation did not sit comfortably in the situational specification. In a similar way recording the nature of the concerns which were the basis for the regulation's original justification was not directly connected to the description of the circumstances which trigger its application. Having a separate segment for contextual references simplifies entry of regulations that have a large number of sub-clauses, as in the case of B1, because of the inheritance function.

9.4.2.2 situational specification

The three subdivisions of the 'situational specification' provide the test of relevancy for the regulation. A substantial number of disputes focus on one of these areas which are closely linked with the general concerns identified in the context of the regulation. Incidentally, they provide extra links with wider debates about the scope of control and whether building regulations are accurately addressing their declared aims[4].

The features of a situation that may give rise to the risks that originally caused public concern are collected in this frame which handles the information referred to by others

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[4] [Cotterell84 p.276]

under various descriptions including; antecedent, protasis, or the operative facts[5]. The slots within the frame are 'domain', 'sub-domain', and 'topic'. These represent the three 'components' of a regulation that together determine the need for certain limits to be observed.

9.4.2.3 response definition

Once it has been established that a regulation is applicable to a particular situation, form of construction, or pattern of behaviour, the relevant response is defined by the three key elements that combine to restrict possible outcomes. This segment has also been described by a number of other terms; consequent, apodosis and deontic obligation[6]. The three 'components' are; 'purpose', controlled 'entity' and 'constraint'. The latter is in one of three forms according to the kind of constraint mechanism invoked.

9.4.3 The components within the segments

Each of the components is also represented by a frame containing pointers to qualifiers applied to the use of the word, or words, in the component description. Identifying the different components that make up each segment was done on a trial and error basis using issues referred to in earlier chapters. Their existence was confirmed and specification clarified by applying the adjusted template to recorded disputes.

9.4.4 The context components

These are: 'references' and 'concerns'.

9.4.4.1 references

In many cases, other documents are quoted to explain certain aspects of the regulation. This is usually done in the Approved Documents but sometimes occurs in the regulation itself, as the case of B1 quoted in detail below. Some of the disputes[7] arise because of differences in interpretation made possible by the different objectives underlying each of the documents. The Prolog program has been confined to only a simple mention of such references. More sophisticated programming would make it possible to define key points of related documents as attributes of the regulation.

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[5] see [Susskind89 p.129]

[6] ibid.

[7] see Appendix B - fifth column

9.4.4.2 concerns

The systems model presented in chapter 4 shows the connection between the development of a regulation because of public concerns or as a result of directions from the Secretary of State acting on behalf of political pressure. It was pointed out that many of these situations are a response to a disaster rather than as part of planned measures designed to achieve a degree of reform. A consequence of this is that regulations are frequently drafted hastily and often quickly revised after a short period when discrepancies are found in their application[8].

Identification of the concerns that brought about the regulation is intended to assist in deciding some questions of interpretation. Comparison with the 'purpose' component of the response definition segment provides a check on achieving the desired objective of the regulation and is a further advantage of recording concerns.

9.4.5 Components of the situational specification

9.4.5.1 domain

The domain defines the scope of the regulation. Consequently, in many building regulations, the domain most generally applied is 'all building works'. In such regulations the content of the 'domain' slot is taken from the "Interpretation" section of *The Building Regulations* "Part 1: General". In some cases the regulation includes a restriction of the domain under "Limits on application"[9].

Differences in the domains of each regulation can be quickly listed by querying the database behind the Prolog program.

9.4.5.2 sub-domain

In most regulations attention is focused on a part of the domain, either by sub-clauses of the regulation, or by reference to Approved Documents. Regulation B1 mentions several sub-domains in the "Limits on application", whereas B2 contains the sub-domain definitions in a table of 'purpose groups' in the Approved Documents.

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8 An example is the modification and eventual withdrawal of regulation G3 dealing with unvented hot water appliances.

9 see G1, the application of which is restricted to dwellings.

The determination of this component is usually an important part of deciding whether or not a regulation is applicable.

9.4.5.3 topic

The function of the 'topic' component is to add a further degree of definition to the situational specification by making clear the subject being covered by the regulation. For example, the heading of Regulation G1 confirms that the subject matter of the regulation is "Food storage". The 'topic' is also useful for cross-referencing.

No examples of disputes about the definition of the 'topic' component were found in those Appeals and Determination analysed.

9.4.6 Components of the response definition

9.4.6.1 purpose

In chapter 2 it was explained that the purpose of a regulation is often difficult to define. Nevertheless, because of its importance in interpretative questions and its relevance to the 'concerns' component, it performs a role in summarising the task of the response definition. It also provides a label for the original justification. It may be a starting point for considerations about revisions to the regulation since it ties in with those issues arising out of a changing environment which may render the regulation invalid, or in need of significant alteration.

In some building regulations the purpose is clearly stated in introductory notes, or in the Approved Documents, under the heading of "Acceptable level of performance".

9.4.6.2 entity

The 'entity' is the object, or in some cases, action, directly controlled by the constraint mechanism. In most cases the definition of the entity is a simple noun or noun phrase taken from the wording of the regulation. The "Interpretation" section of the building regulations includes some definitions, which add further details that can be included in the qualifiers for the entity.

There is usually a relationship between ' entity' and 'topic'.

9.4.6.3 constraint

The 'constraint' is that component which determines the regulation's precise effect and frequently contains quantitative limits.

The constraint component takes one of three arrangements. In its most simple form the regulation requires the presence of a particular entity. A slot containing the value 'shall be' represents this, and many of the building regulations in the Statutory Instrument take this form. The second form of constraint is where the entity is required to have a particular feature such as "being satisfactorily sited". This type of constraint is also present in the Statutory Instrument but is expanded into the third type of constraint by the Approved Documents. In the most usual case, the constraint requires that the entity shall have a feature that has defined limits. Most regulations within *The Building Regulations 1985* have limits set that represent either a maximum or a minimum level. Where quantitative limits are given they usually occur in the Approved Documents.

This subject is explored further in Section 9.8 because of the special importance of the constraint mechanism.

9.4.7 Frames that act as qualifiers

Schauer has presented the argument that every prescriptive rule is a form of generalisation. To cater for this position, each component is assumed to have at least this one level of qualification. The two other qualifiers provided by the program are entrenchments and inclusiveness. The program asks whether there are any further slots required by the representation to incorporate extra qualifications.

Qualifiers account for the more subtle shades of meaning that are incorporated into a regulation and which may change over time.

9.4.7.1 generalisations

In many cases, the generalisation can be determined from the relevant Approved Document, which contains further levels of description. The application of this can be seen in most of the examples in Appendix B. Despite the nature of the Prolog program, which restricts the amount of detail that can be provided, the frame-based approach allows for enough detail to demonstrate the operation of generalisations[10].

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[10] Case 2 in Appendix B is an example where the dispute is rooted in the generalised description of an escape window.

9.4.7.2 entrenchments

Schauer writes extensively about the ways in which entrenchments operate to strengthen prescriptive rules by resisting pressures to be modified in the face of what he calls "recalcitrant experiences".[11] Many of the entrenchments that have been added to the analysis of regulations by using the Prolog program are based on empirical experience and as such are open to discussion. However, by drawing attention to the possible existence of entrenchments a more precise picture can be constructed of the way regulations work. For example, in defining the entity that is the focus of the B1 series of regulations, we can see that protection is an essential aspect of 'means of escape' although this attribute is not called for in the regulation or the "Mandatory Rules".

Industry knowledge is such an important part of successfully interpreting regulations, because entrenchments are inferred from experience of the industry to which they relate.

9.4.7.3 inclusiveness

Schauer reminds us that the behaviour described by a rule may not always exactly address the intended target of the rule referring to the phenomenon as over- or under-inclusiveness. He goes on to point out that all rules are either actually or potentially over- or under-inclusive, emphasising that "these terms should not be taken to indicate defects"[12]. In the case of building regulations this aspect of a component of a regulation is noted to reveal the possible existence of situations that are not wholly inside or outside the definition being used. In the main, the aspect of inclusiveness is 'under-inclusiveness' because it is possible to envisage conditions that might arise and are not covered by the description. It is often these situations that give rise to uncertainty in deciding if either the regulation applies or on determining a response that complies.

9.4.7.4 non-standard qualifiers

In some regulations there are one or two extra pieces of information that are relevant to certain components. An example is the qualification that some of the sub-domains of B1

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[11] He reminds us of the many different words used by the Inuit Indians for 'snow' and which we generalize under the one inclusive word. He goes on to say that therefore entrenchments make the properties surpressed by a generalizations less subject to recall on demand. He infers that an entrenched generalization moulds our imagination and apprehension in such a way that methods of thinking, which would focus on different properties, become comparatively inaccessible. [Schauer91 p.42]

[12] [ibid. p.32]

deal only with a building that "is erected". This distinction lies at the root of a number of reported disputes,[13] and is the probable point for providing pointers to case law.

9.4.8 Summary

The foregoing description deals with each of the parts that make up building regulations. Using these consistently as interconnected frames within a Prolog program it has been possible to analyse a large sample of the building regulations. In addition these representations have been used to find out more about the nature of all recorded disputes analysed in this way.

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[13] See Appendix B.

9.5 USING THE PROCESS TO ANALYSE DISPUTES

The process of analysing a dispute is in two parts: entering the regulation into frame-based format; and annotating the resulting output after consideration of the report of the dispute.

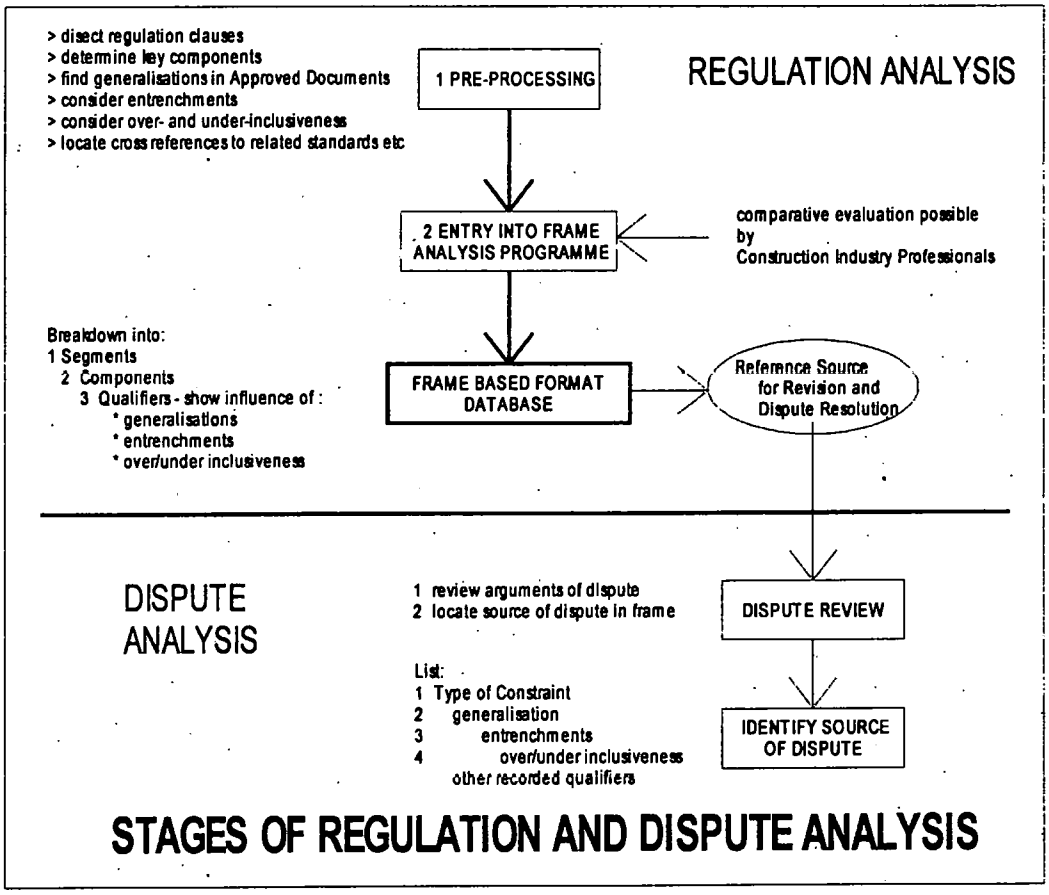

FIGURE 9.3

9.5.1 Pre-processing and modelling the regulation

The first step in analysing a regulation is to mark up a hand-written version[14] to identifying key phrases and the number of discrete clauses. These arise from the sub-clauses or sub-domains listed in the regulation or Approved Documents. The generalisations are identified by inspection of the text and the entrenchments from experience. Considerations of over- or under-inclusiveness are taken into account by visualising conditions that might fall inside or outside the boundaries set up by the verbal descriptions.

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[14] see Appendix E for a typical example

The next step is to run the Prolog program and answer the prompted questions. This works as an interactive checklist by offering previous examples of segments and components already in its database. Where only a single aspect of an element requires modification the program obtains the additional information and writes a frame that can inherit the common elements when queried. Where it is not possible for segments to be linked in this way a fresh segment is created, together with the relevant components.

Output from the database can be sent direct to the printer or to file for sending to a word-processing package later.

9.5.1.1 results of analysing a regulation

Regulation B1 is the only one for which the supporting document is mandatory. The remaining documents are termed 'Approved Documents' and are regarded as demonstrating compliance with the Building Regulations. The option of adopting other forms of construction is not ruled out as in the case of B1. This regulation was the source of the largest number of disputes over the period reported by the Department of the Environment. For this reason it is the regulation used most frequently as a point of reference for examples.

The full text of the regulation is as follows:

" B1. - (1) There shall be means of escape in the case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.

(2) This requirement may be met only by complying with the relevant requirements of the publication entitled "The Building Regulations 1985 - Mandatory Rules for means of escape in the case of fire" published by HMSO (1985 edition)."

limits on application
"1. This requirement applies only to -
(a) a building which is erected and which -
(i) is or contains a dwelling-house of three or more storeys,
(ii) contains a flat and is of three or more storeys,
(iii) is or contains an office, or
(iv) is or contains a shop;
(b) a dwelling house which is extended or materially altered and will have three or more storeys, and
(c) a building of three or more storeys, the use of which is materially changed to use as a dwelling house.
2. The means of escape provided need only, in the case of a dwelling-house or a building containing a flat, afford escape for people from the third storey and above and, in the case of a building containing an office or a shop, afford escape for people from the office or shop."

The results from analysing the regulation are as follows:

SECTION, REGULATION NUMBER and SUB-CLAUSE: B1

The CONTEXT of < means_of_escape_fire > is:

references: **bRegs85_mandatory_rules**
generalisation .. mandatory_rules
entrenchment .. fire_escape_regulations
inclusiveness .. under

concerns : **death_or_injury_from_fire**
generalisation .. suffocation,burning,collapse

The SITUATIONAL SPECIFICATION for < fire_precautions > is:

domain : **buildings**
generalisation .. permanent,temporary,part,over_2_storeys
entrenchment .. with_roof_and_walls
inclusiveness .. under
qual .. is_erected

subdomain : **restricted_by_clause**
generalisation .. none

topic : **In_case_of_fire**
generalisation .. combustion
entrenchment .. permanent_fire_risk

The RESPONSE DEFINITION rd(rB1) is:

purpose : **safe_escape**
generalisation .. rescueable
entrenchment .. within_30_mins
inclusiveness .. under

entity : **means_of_escape**
generalisation .. [safe_route,structural,
from_any_point_in_building
entrenchment .. protected
inclusiveness .. over
qual .. to_place_of_safety_outside

The CONSTRAINT: entity shall have bounded feature:
capable_of_being_used
generalisation .. without_assistance
entrenchment .. by_ambulant_persons
qual .. safely_and_effectively

lower bound: **at_all_material_times**
generalisation .. none
entrenchment .. continuously
inclusiveness .. over
upper bound: **no_max**
generalisation .. no_upper_limit

To make it easier to read the output the brackets and symbols required by the program have been taken out. In addition the headings in the text and component values have been emboldened to emphasise the overall structure.

9.5.2 Annotating the results

In order to add the details of recorded disputes, the results of analysing a regulation clause are compared with the report of the Secretary of State's decision. The details of the decision indicate which components were under discussion and which particular element was at the heart of the disagreement. The analysis of the regulation can then be filled out with annotations reflecting the arguments put by both sides. This method was used to test completeness of the model and to ascertain whether it is capable of reflecting the full details of the dispute.

The Prolog program can also be used to run special queries to explore different aspects of the database and to make comparison between similar elements for example, by looking for all instances of entrenched domains. A full description of the process applied to the most contentious regulation is given later.

9.6 THE PROLOG PROGRAM

9.6.1 Advantage of using Prolog

The research involved continuous manipulation of groups of words taken from the building regulations and similar examples of legislation. To ensure a consistent technique a tool was required that placed few restrictions on the data structures until a satisfactory form emerged. Prolog was selected for its flexible handling of data structures. In addition the language has been extensively used for experiments in natural language processing and attempts at representing regulations. More recently a derivative of Prolog has been developed for constraint logic programming.

Learning to use the language provided an additional benefit in that it gave an introduction to many of the concepts involved in processing written statements. Much of the literature on the application of the Prolog language deals with concepts closely connected to the problems of processing prescriptive statements and opened up avenues for further investigation.

By examining the building regulations in this way inconsistencies emerged within the model which demanded some adjustment to logical links or terminology. As regulations were analysed, extra refinements were added until it became possible to achieve a realistic representation without further changes being required. For example, when modelling regulation B3 (which deals with fire spread) it became clear that the handling of context was inadequate. Accordingly the way in which context should be connected to the situational specification was reviewed. It became apparent that a frame at the segment level was needed for storing contextual links. The need for a higher level to represent the Building Act from which The Building Regulations are descended was also considered. This has been omitted for simplicity because it would occur in every regulation referred to by this dissertation. However it is important to take into account that each regulation in model would inherit the characteristics of a frame which includes these references in a complete representation.

9.6.2 Prolog limitations

In many cases slot values have been abbreviated to keep within restrictions imposed by the Prolog language on the maximum size of record unit. In a more developed version of the program, perhaps using a different computer language, it would be feasible to insert the complete definition taken from the source document.

The previous chapter gave examples of the main options available for the use of Prolog to assemble frames for storing data. To a greater or lesser extent the format chosen has an influence on the data structures which can be represented and on the subtlety of operation. The most important feature of the structure chosen is that the values for each element can be either a single word[15], or lists. Lists are especially useful where an element has several values that are quite distinct, as in "safe_route, structural".

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[15] phrases are made equivalent to words by linking with underscores, as in "means_of_escape"

9.6.3 Program structure

The final version of the program comprises four modules carrying out tasks related to the entry and display of regulations. The Prolog code, with an introductory description, is given in Appendix D.

Two of the modules, the data entry routines and the query mechanism, interact with the user and have a significant influence on the success of the process.

9.6.3.1 data entry routines

The questions raised by the program assume some pre-processing of the regulation as described above. The original intention was to provide a simple parsing front-end but in view of the rapid progress made in this field in recent years, the task became disproportionately large in comparison to the amount of extra information that it could provide. Answers are required as single words, phrases with words linked with under-scores, or as a list of either form.

If it is later found necessary to modify the entry this is done using a text editor to avoid building a series of editing predicates which add nothing to the value of the dissertation.

9.6.3.2 query mechanism

Two main options are built in to the program. The first displays the regulation structure without the qualifiers to give an overview of the regulation's contents. The second displays the regulation complete with the qualification of each component. Some extra queries that are used frequently have been provided as 'process' predicates. Prolog in most cases makes it sufficient to query the database with queries entered as required.

The distinction between the 'real'[16] and written regulation frequently arises in the case of building regulations, in interpretations during face-to-face negotiation. Control officers who wish to impose "letter of the law" approach focus on the written statement because they are less concerned with the 'real' regulation. There is a trend nowadays towards a more liberal approach to interpretation and the greater freedom created by the regulations has led to a more particularistic approach to control.[17]

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[16] [Dworkin86 p.53-76]

[17] [Baldwin90 p.336]

9.7.1 Dispute Analysis - B1 (sub-clause 1(B) of the Limitations)

One example regulation is now described in detail to illustrate the existence of an internal structure as expressed through the template. It also shows the implications for analysis of disputes. The example selected is regulation B1 - the source of the largest number of Appeals and Determinations reported in 1989. Of these more than half were concerned with loft conversions.

Number 7, in the reference group of disputes (see below), is an example of such an appeal against a decision of the local authority. It is quoted in full to illustrate two points. Firstly, the example provides a comparison between the regulation as originally formulated and the results obtained from analysis. Wherever possible, the analysis uses the words used in the regulation to form the most robust alternative representation. Secondly the report of the dispute can be examined in the light of the analysis.

The general make up of clause B1 has already been described. The various sub-clauses of the regulation define the particular relevance of each aspect of the regulation. For the case under examination the sub-domain is the clause concerned with loft conversion and the applicant chose to select the constraints imposed in Appendix B of the mandatory rules which lay down very detailed requirements appropriate only to loft conversions. The sub-domain is defined as follows:

(b) a dwellinghouse which is extended or materially altered and will have three or more storeys.

Analysis of the whole of the clause created by the declaration of this sub-domain produces the following breakdown:

SECTION, REGULATION NUMBER and SUB-CLAUSE: B1 1 (b) Appendix B

(required to identify uniquely this version of the regulation)

CONTEXT of < means_of_escape_fire_loft_conv > is:

references: **bRegs85_mandatory_rules,bS5588_s1**

generalisation .. mandatory_rules,
cp_single_family_dwellings
entrenchment .. fire_escape_regulations

inclusiveness .. under

concerns : **death_or_injury_from_fire**

generalisation .. suffocation,burning,collapse

Comment : The segment above is inherited from the general clause and was not disputed in this appeal.

SITUATIONAL SPECIFICATION for < fire_precautions_loft > is:

domain .. **building**

generalisation .. permanent,temporary,part,over_2_storeys
entrenchment .. with_roof_and_walls
inclusiveness .. under
qual .. is_erected

subdomain .. ***loft_conversions**

generalisation .. one_or_two_habitable_rooms
entrenchment .. in_roof_space
inclusiveness .. under
qual .. new_storey

topic .. **in_case_of_fire**

generalisation .. combustion
entrenchment .. permanent_fire_risk

Comment: 'Domain' and 'topic' are also inherited from the general definition of regulation B1 but this segment is different in the definition of the sub-domain. This makes provision for the special case dealing with minor works within the roof-space of dwellings and where there are one or two habitable rooms in the new storey. This segment was not disputed, but is responsible for triggering the relevant response definition.

characteristics of RESPONSE DEFINITION are:

purpose .. **safe_escape**

generalisation .. rescuable
entrenchment .. within_30_mins
inclusiveness .. under

entity .. **means_of_escape**

generalisation .. safe_route,structural,
from_any_point_in_loft
entrenchment .. protected
inclusiveness .. over
qual .. to_place_of_safety_outside

Comment: *this last item has been put in bold type to emphasise that it is the location of the dispute. The definition of 'purpose' and 'means of escape' is inherited from the general definition of regulation B1. In the report of the case quoted below, the focus of the dispute is located in the qualification of 'means of escape' to a 'place of safety outside'.*

CONSTRAINT .. entity shall have bounded feature:

useable,fire_door_protection,escape_windows

Comment: *For works involving loft conversions the constraint imposes special limits tailored to the constructional and spatial characteristics of such situations. There are three features that are bounded by the regulation; usability, fire door protection and provision of escape windows. The first of these is taken from the general definition. Details of the second and third are set out in Appendix B to the Mandatory Rules. For convenience the three bounded features have been combined whereas the Prolog processor handles each by generating three separate regulation definitions.*

useable:

generalisation .. without_assistance
entrenchment .. by_ambulant_persons
qual .. safely_and_effectively

lower bound: **at_all_material_times**

generalisation .. none
entrenchment .. continuously
inclusiveness .. over

upper bound: **no_max**

generalisation .. no_upper_limit

fire_door_protection

generalisation .. fire_resisting_enclosure,self_closing
entrenchment .. half_hour
inclusiveness .. over
qual .. to_BS476_part8

lower bound: **all_doors_to_enclosure**

generalisation .. none

inclusiveness .. over

upper bound: **no_max**

generalisation .. no_upper_limit

escape_windows

generalisation .. window,rooflight

entrenchment .. openable

inclusiveness .. over

lower bound: no_min

generalisation .. only_maximum

upper bound: cill_max_1100

generalisation .. to_bottom_of_opening

entrenchment .. from_floor_level

inclusiveness .. over

Comment: *It should be noted that the attributes of the constraint portion of the regulation clause do not take into account the possibility of disabled persons living or sleeping in the new storey. No provision is made to cover an able bodied person who has been confined because of temporary injury which may make it impossible to escape in the fashion envisaged. Exploration of the full details imposed by regulatory clauses reveals this type of omission or inconsistency.*

Report of Appeals and Determinations 1989 - number 7

The report of the appeal[18] is quoted in full to illustrate how the information it contains adds to our understanding of the regulation and points to a specific component as the nub of the disagreement regarding the application.

" The proposal was for a loft conversion to add a second floor to an existing house and the work also included the conversion of the attached garage into a living room.

Comment: *the intended use determined the relevant sub-clause*

The appellant has used the means of escape option given in Appendix B of the Mandatory Rules but a relaxation of Part B1 in respect of the new storey was refused.

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[18] The extract is taken from the April 1989 report of selected Appeals and Determinations published, by the Institute of Building Control with the permission of the Department of the Environment.

Comment: *choosing the optional Appendix placed the proposal into the version of the regulation with constraints applicable to loft conversions*

A bedroom with attached bathroom was to be built under a new dormer and the stairway would be extended up to the new floor. Fire resisting construction and a half-hour fire-resisting self-closing door would separate the stairway from the new storey at the head of the new stair.

Comment: *this refers to the second bounded feature*

A window in the new bathroom was to serve as the alternative exit from the second storey.

Comment: *the alternative exit is the third bounded feature*

This window gave access to the flat roof of a part of the first floor. At the front, this roof overlooked the roof of the ground floor accommodation that was being converted from the garage. At the back it overlooked a two-storey drop to the back garden.

Comment: *these are the conditions relevant to the means of escape*

In the Council's written representation the flat roof outside the exit window was objected to, as it was not half-hour fire resisting. Furthermore, it was also considered that there was only tortuous access for a ladder to the other windows of the new second floor, because parts of the lower floors protruded at the back of the house.

Comment: *concerns raised about the usability and safety of the means of escape*

It was accepted that in the longer term a fire in the first floor bedroom beneath the flat roof or in the converted garage could break through the roof and prevent its use as an escape route. However, a similar risk is normally accepted by allowing ladder rescue. No requirement for fire resistance in external walls in the zone where the ladder will have to be set up is made and flames through an open or broken window mean the ladder would be just as dangerous. In fact it would almost certainly take longer for the roof construction to be broken through than it would for a window to break.

Comment: *Balancing considerations about the usability and safety of means of escape*

It was considered that a ladder could be set up to the relevant flat roof from the back garden without any obstruction. As there was no route round the side of the house to take a ladder, rescuers would have to cross from the next house, which does have a side passage.

However, the roof form was such that it would be possible to reach ground level at the front of the house in stages, by dropping from the first floor roof to the ground floor roof, and hence either to the neighbouring property or, by climbing down railings, to drop to the ground at the front of the house. This is a similar situation to any first floor room, from which it is accepted that people can escape unaided or by jumping.

In the circumstances it was considered that the proposal was acceptable and the Secretary of State therefore allowed the appeal."

The applicant can be seen to have complied with the constraint limits, two of which in this regulation represent minimum criteria and one a maximum limit. However, the focus of the Council's objection was that characteristics of the means of escape did not ensure that it led to a place of adequate safety.

It can be seen that at this point the regulation 'runs out', because the characteristics of a 'place of adequate safety' are nowhere defined. Assessment of features needed to comply with this stipulation is left to local interpretation unless a more formal decision is obtained, as in this case. There is a measure of particularisation in the way that the benefits of the various features of the buildings were taken into account to arrive at a determination.

The report of the decision adds detail to the characteristics that could be associated with such a location. They could be cross-referenced by an elaboration of the Prolog program to highlight a decision that is effectively the equivalent of case law as developed by the report of the appeal.

9.8 THE CONSTRAINT MECHANISM

This section of this chapter is devoted to the special importance of the constraint mechanism because of the significance of its role in regulations, and the possibility that a similar mechanism is present in all rule formulations. The concept is termed a 'mechanism' because it operates deterministically and without reference the other parts of the regulation. Furthermore, it is possible for the same mechanism to be attached to other situational specifications to assemble new regulations. The constraint within a regulation is the only component, which if removed, completely removes its force, and is the only element that has more than one possible form. Attempts at representing regulations in frame based format have drawn attention to the existence of the constraint mechanism. Most of the examples quoted from the list of DoE approvals and determinations, were arguments about the precise effects of the actual limits imposed.

A constraint is an operator that sets limits on the values of attributes or characteristics and we see examples of them in all walks of life. They are usually embedded in rules and regulations. For example in everyday experience people say that they feel "constrained" by such and such as if there were a rule in operation. An example of this is when people observe social constraints in dress or behavioural conventions. At this level constraints are perhaps more apparent within social mores because people are more aware of the limits themselves than the enclosing rule structure. The proposition derived from this thesis is that there is a section in each regulation, or rule, that sets permitted limiting values for some controlled entity.

9.8.1 A systems view

Wilden[19] presents a broad view of systems which includes describing the functional relationship between constraints and the structure of various types of system. In particular, he makes several observations about the significance of constraints in systems that are evolving as opposed to static systems in equilibrium.

He writes[20] that

> "a system distinguished from its parts by its organisation it is not an aggregate. We may consequently say that the behaviour of the whole is more complex than the sum of the behaviour of its parts. However, since the organisation of the whole imposes a constraints on the behaviour of the parts, we must also recognise that the semiotic freedom of each subject in itself is greater than its semiotic freedom as part of the whole and may in fact be greater than that of the whole."

He suggests that constraints have a direct influence on the evolution of an organism, a parallel that supports the concept of regulations as important in innovative situations:

> "In other words a description of the possible behaviour of the organism in itself is inadequate without a description of the constraints exerted on those possibilities by the environment. Or in Bateson's terminology cybernetic explanation is of a different logical type from causal explanation: in this perspective it is not a question of why such and such happened but a question of what constraints operated, whether it was the same old thing or anything at all didn't happen."[21]

Market entry in some industries is delayed until there has been clarification of the regulatory environment and the exact nature of the risks implied by the constraints that are imposed.

9.8.2 Constraints in Design

Brian Lawson describes the function of design constraints and the way in which they may affect design of a building in his book on the subject of how designers think.[22] Constraints

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[19] [Wilden80] *System and Structure*

[20] [Wilden80 p. 203]

[21] [ibid. p356]

[22] [Lawson80, p76]

range from those imposed by the client, legislators and the designer himself in order to impose some sort of structure on the design problem. In his view constraints which may be self-imposed by the designer act to organise the solution in a way that not only satisfies the constraints but also makes use of them to develop an interesting solution.

Hopgood quotes Sriram et al "(Design) is the process of specifying a description of an artefact that satisfies constraints arising from a number of sources by using diverse sources of knowledge". Writing about conceptual design he says " Preliminary decisions are made at this stage, with the aim of satisfying a few key constraints". He goes on to imply that the detailed design stage is a process of checking that all constraints are satisfied.[23]

An important aspect of the role of constraints is this link with the design process because of the way in which they delineate the solution space. Hopgood points to the potential dangers of applying numerical constraints too rigidly and refers to the work of other researchers who have investigated the role of fuzzy constraints. The solution set of constraints for a given form of construction or process is the result of evaluating the interaction between the features and ranges of vector values set by the relevant regulations. For example in Section G, clause 1 is supported by the Approved Document in which there are three sub-clauses each with a constraint dealing with size, access and ventilation. These may be said to define the solution space for an acceptable food-store.

Sometimes in the design process, attempts are made to identify constraints so that new constraints arising out of decisions taken so far can be allowed for when making subsequent decisions. Hopgood points out that this approach is closely connected to truth maintenance, which ensures those subsequent detailed investigations are related to the correct premise. A Prolog example is given which "shows how a constraint affecting one part of the design (viz. the orientation of the battery at the top of the holder) is propagated to determine some other part of the design (viz. the orientation of the other battery)".[24]

There appears to be some similarity between the problems of open texture in language and the risk of applying interpretation of prescriptive rules that are too rigid. This is an area that could be investigated further.

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[23] [Hopgood92, p243]

[24] [ibid. p259]

9.8.3 Structure of the constraint mechanism

Analysis of the internal structure of regulations has shown that the constraint mechanism has one of three alternative forms, of which the third is the most usual in *The Building Regulations*. This states that the controlled entity shall have a feature with the values of one or more of its attribute kept within a defined range. In most cases found, there is only an upper or lower limit imposed. In the primary regulatory statement such a limit may be fairly general as in "shall be adequate". The details of 'adequacy' are made explicit in the Approved Documents or related documents.

In technical regulations, such as the Building Regulations, requirements are often stated with fixed limits e.g. Section G regulation 3A requires that the temperature of the stored water at any time be prevented from exceeding 100 deg. C. This can simply be represented by an upper limit with no lower limit having been expressed. However most examples taken from the Building Regulations, because of their structure into a primary document supported by approved documents, take the form of descriptive clauses such as: G4 - "sufficient sanitary conveniences shall be provided... ". Approved Documents then stipulate the interpretation of "sufficient" in terms of numbers of users, building type etc. and sufficiently precise criteria are attached to the regulation for the boundary limits to be established.

9.8.4 Control systems

It has been suggested that a key part of the operation of a control system is the way in which constraints are imposed. Bennett and Chorley describe ways of looking at decision-making systems governing human activity with mathematical formulae used to demonstrate the significance of feedback links and monitoring processes. Their emphasis is on dynamic systems rather than the more static view taken by commentators on regulations. Comparison of the model put forward in chapter 3 with some of the models presented in their book show that feedback loops are not part of the fabric of building regulations.

Because of the highly mathematical nature of their work, cost is suggested as a common measure of success in control decisions. This makes it appropriate to use mathematical

formulae in conjunction with graphs to support their arguments exemplified by a case in which the control problem is described as:

" ... to shift the system from an initial point to a desired final point in one step with minimal cost. This can be stated as:

Maximise (or minimise) W(Y) = f(U1t,U2t,.....,Uit,.....),
Subject to the constraints g(U1t,U2t,.....,Uit,.....) =< P."[25]

By reflecting the constraints as a list of values occurring in the solution set this is similar to the format used in constraint logic programming.

This thesis suggests that the importance of the constraint mechanism is that it is the point at which a regulation bites. It is in the determination of the upper and lower limits of a constraint that decision making in relation to risk actually takes effect. As has been suggested by Schauer in his discussion about the inevitable errors that arise in designing rules "the designer of a regulation has to assess the likelihood of compliance and the probability of some degree of laxity in the regulation being observed".[26] For this reason, determining constraint limits is seen as the most important feature in construction a regulation.

9.8.5 Establishing constraints

It has been shown that the constraint component is where most disputes occur. Experience shows that it is also the biggest area of uncertainty when trying to apply regulations. There are various methods used to establish upper and lower bounds for meeting objectives of regulators. The first of these is empirical; where industry conventions or common knowledge suggests suitable boundaries for limiting values. The second is by agreement; where industrial representatives work with the drafters of the regulation to achieve acceptable boundaries. The third is a process of trial and error; usually adopted when new techniques or forms of construction are envisaged.

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[25] [Bennett/Chorley78, p131]

[26] [Schauer91. p.154]

Potential subjects for further research are how the boundaries are defined and what are the decision-making processes involved. Further research may find that fixing the range of the constraint plays a crucial role in determining how a regulation performs.

9.8.6 Constraint logic programming

Constraint logic programming is a development of logic programming, where unification, the basic operation of logic programming languages (e.g. Prolog) is replaced by constraint handling in a constraint oriented environment. Constraint language programming is seen as a task well suited to Prolog in view of the declarative nature of the language. It uses a variety of constraint satisfaction techniques and can be described alternatively as constraint satisfaction programming.

The basic principles are described in a paper in the journal *Knowledge Engineering Review* by Pascal van Hentenryk. The initial example given[27] reflects the split between the situational specification and the response definition by defining the former as 'state domains' and the latter as 'state constraints'. The techniques use many of the methods used in assembling a frame-based format to represent regulations. The essential ingredient in each approach is a series of constraints and for this reason is likely to offer significant potential for further research.

9.9 EVALUATING THE THEORY

Computer analysis was chosen as a way of investigating the internal structure of regulations to show that a regulation or sub-clause can be broken down into its components in a deterministic way. The product of the research has been a frame-based database that represents examples *of The Building Regulations 1985* in accordance with the template described above.

Information from reports of appeals and determinations has been used in this research to ascertain which aspects of regulations occur consistently and need to be present in any alternative version. Tracing the different issues that lay behind each of the recorded disputes has tested this theory. To establish that the template accurately represents each

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[27] [Hentenryk91, p153]

regulatory clause, a number of representative building regulation clauses were entered into the system. The example results are included in the Appendix A and a comparative analysis in Appendix B.

A range of methods were considered to establish the validity of the form of the internal structure revealed by the investigation. Three methods were explored in detail: parsing; automatic reconstruction; and depicting disputes. The first two both entailed using parsing operations and required programming skills beyond those available for this project. The second also implied the application of generative grammars, comparable in complexity to parsing algorithms, and would have greatly extended the scope of the investigation.

9.9.1 Answers to key questions confirm the existence of an internal structure in regulations

The method eventually selected i.e. the modelling of recorded disputes, is the third of the three listed above. This requires the production of a sufficiently accurate representation of the content of each dispute. This representation must establish that all the essential, and sometimes very subtle, issues raised have been correctly depicted.

The questions which help us evaluate the success of the template in embodying the internal structure of regulations are:

> can the template be re-used repeatedly to represent any building regulation?
> can it do this without modification?
> does the same process apply to the representation of disputes without alteration to the template?
> does the application of the template to the representation of disputes in this way pick up all the issues involved in the dispute?

The results of the investigations and experimental analyses give affirmative answers to these questions. This has been done by showing that all essential features of the regulations and disputes have been fully portrayed for the target set of regulations.

On this basis, it is therefore asserted that the results of the research described in this dissertation have successfully proved the existence of a repeatable internal structure within *The Building Regulations 1985.* A predictable set of connections and functions for the different elements portrayed has been found and validated by representing all aspects of the disputes that were analysed. A frame-based template has been used, which does not need to be changed from one regulation to another.

It can of course be argued that this approach neither proves the existence of an internal structure, nor that the structure recognised is the only correct version. Nevertheless, because the internal structure put forward can repeatedly reduce a regulation to its essential ingredients there is a strong case for the validity of the structure proposed. Furthermore, by reconstructing regulations in this way it has been demonstrated that the template encapsulating the internal structure contains all the ingredients needed to assemble a complete regulation.

9.9.2 Testing the structured data by using it to predict decisions

This research was prompted by the divergence in opinion among LA officials and apparent experts about the real meaning of regulations and their application in given situations. A further means of testing the accuracy of the template would be to compare the results obtained from a panel of experienced Building Control Officers with those obtained using the framework created by the structure to predict the decision.

In its present form the program's 'user interface' is not designed to make it easy to arrive at predictions about probable outcomes of disputes or interpretations of regulation requirements. It is necessary to interpret the database manually to make such judgements. However, it would not be a large amount of work for a skilled programmer to construct a suitable front end to enter the details of a dispute, or a question about compliance, in an appropriate format. The program would then compare the new data with the regulation frames and obtain answers to a series of questions to arrive at a predicted decision. The prediction could then be compared with collective or individual decisions of panel members.

The type of tests that would be applied to the situation being described would be as follows:

- does the situational specification apply – that is, are the domain and sub-domain and topic applicable when taking into account the generalizations and any entrenchment recorded?

- if so, what are the features of the situation which confirm that it applies? This list would be a basis for discussing alternative interpretations and considering the implications of the influence of over- or under-inclusiveness.

Where there is doubt, the program might be directed to review expanded context frames to supply additional information about over- or under-inclusiveness.

If it were found that the description of the situation envisaged matches the regulation frames then the program would turn to the proposed response.

– does the controlled entity have the required feature and is it within the limits set by the regulation?

The process set out above follows the same decision steps that would be required by someone manually using the information provided by the frames. To function effectively the enhanced program would need access to a much-expanded lexicon of word equivalents. The data stored in the frames would require considerable embellishment to support a reasonable degree of flexibility in operation.

The initial benefit to be obtained from processing regulations in this manner would be to make it easier for the form and content of the internal structure to be compared with the views of "experts" in the field. If needed, adjustments can then be made to fine- tune the interface and the frame structure.

9.9.3 Limitations of the analysis process

From the description above it is clear that more work has to be done before the internal structure revealed by this research can be converted into an "intelligent assistant" to complement manual access to regulations. However the stages necessary to construct such a program are not hard to envisage and the result would have a variety of applications. These range from a reference source for those drafting new regulations to an on-line advisor for CAD operators and building designers.

Limitations stem from dependence on historical information and the inability of the system to consider situations or responses that have not been entered into the knowledge base. The context frames are only "hooks" in their present form to locate an expanded frame-based reference giving access to more detail about associated legislation and standards.

Despite these limitations, a program using the frame-based format for storing data about regulations should provide a secure basis for an auditable development cycle able to receive additional data accumulated from its experience in the application of regulations.

It is reasonable to suggest that a developed version of the process could operate as an "intelligent assistant" in a number of ways. The program could compare descriptions of the situation relating to a particular case and help to determine if a regulation applied. It should also be able to test the proposed for a construction solution and test for compliance.

In addition, through the network of related frames, it should be possible to trace the features and conditions controlling the outcome of the enquiries to the program.

Such an "intelligent assistant" could also help in the drafting of regulations by logging connections to related legislation and maintaining an audit trail of generalisations, entrenchments, and the influence of over- and under-inclusiveness.

Perhaps the largest area for potential application is in assisting in interpretation of 'hard' cases. Highlighting relevant issues and clarifying how the key relationship between 'justification' and 'purpose' has been catered for in the present form of the regulation should be of real value to those looking for its 'real' meaning.

CHAPTER 10 CONCLUSIONS

Abstract

The propositions put forward in the introductory chapter are now considered in the light of the research results and it is found that they are supported by the findings of the research.

The main output of this study has been confirmation of the existence of an internal structure that can be used to represent the Building Regulations 1985. This takes the form of a template, which has been shown to be consistent across the target set of regulations.

An additional discovery is evidence for the key function of the constraint mechanism, which is the core component within each regulation, and responsible for its actual effect.

Information was provided about the form of an internal structure within The Building Regulations 1985 by examining the causes of uneven application of regulations.

Arguments supporting the propositions are reviewed against a background of issues raised by earlier chapters. Several questions were raised by the investigation which have suggested possibilities for further research and the possible additional insights that could be obtained are discussed. Weaknesses in the arguments presented in the dissertation are mentioned to assist in assessing the value of the work.

10.1 RESULTS

Arguments have been presented in this dissertation which have confirmed the three propositions set out in the initial introduction.

The propositions are:

- the two major causes of the uneven application of regulations are on the one hand, determining which situations trigger individual regulations; and on the other, agreeing the constructional methods which achieve compliance,
- a systematic procedure for the analysis of regulations has been developed from the investigation into their internal structure,
- advantages can be obtained by computerising the procedure for identifying the key issues in any dispute relating to *The Building Regulations 1985*, and possibly for other sets of regulations.

The main outcome from this research has been the development of a template for analysing regulations, which has been achieved by considering the implications of the first proposition. In addition its emergence supports the second and third of these propositions. The template takes the form of a series of frames and slots which when filled are able to represent example regulations taken from *The Building Regulations 1985.* A further result, potentially of equal interest, comes from the isolation of the key role carried out by the constraint mechanism in setting the operating limits imposed by the presence of the regulation. This last feature of regulations may be found of use in producing on-line assistance for CAD operatives and to support design activities by speeding up methods for delimiting the solution space of a given task.

10.2 IMPACT OF REGULATIONS

Regulations are limits imposed on our activities from a wide variety of sources and are the form in which most legislation is of direct affect on our daily lives and on the technical infrastructure of modern life. Regulations can be regarded from a number of viewpoints: as a control system; as documented learning; and as a snapshot of a particular social group's attitude to external pressures.

Different interpretations, uncertainty regarding their effect and disputes are the main problems associated with regulations. Despite these complications we live in an increasingly regulated society. Attempts to reduce the number of regulations have been largely unsuccessful as each piece of legislation is examined and often found to perform some necessary role in protecting an aspect of our daily lives.

Since it seems likely that people and organisations are going to have to put up with more rather than fewer regulation it is suggested that we can benefit from increased understanding of as much as possible about their operation. Where regulations do not fulfil their original intention or where they cause unnecessary restrictions they may need to be adapted or discontinued. Having a clear definition of the initial justification is just part of the process of exercising some control over their proliferation. It is also the starting point when deciding if a regulation should be revised or abandoned.

Interviews have confirmed that, despite regulations affecting just about everything we do, there is a surprising lack of understanding about how they operate and control our activities in interacting with other people and organisations. Increasing imposition of directives from the European Union will extend our involvement with regulatory systems and the absence of methods for comparing their performance may lead to time wasting and extra cost.

The original goal of this investigation was to find evidence for an internal structure to regulations and whether it could tell us anything useful about their operation. This has

been achieved by using *The Building Regulations 1985* as an example and a reference for generating illustrations of the proposed methodology.

10.3 THE PHENOMENA OF REGULATIONS

10.3.1 Separating regulations from rules and norms

Regulations, rules, and norms have overlapping core meanings and section 2.3 attempts to clarify the distinction for our purposes.

Schauer's views, described in chapter 2, provide definitions and concepts to reason about the ways in which regulations operate. His analysis gives particular significance to the notions of *generalisations* and *entrenchments* in the composition of prescriptive rules. The phenomenon of generalised entrenchment explains why differences arise between the original meaning of the rule and the version that comes to be accepted over time. The effects of over- and under-inclusiveness are also dealt with by reference to Schauer's writings. This is a difficult concept to integrate into a data structure because a set of conditions can be both over- and under-inclusive at the same time, when considered from different viewpoints. Variations in the extent of inclusiveness may reveal a possibility for alleging 'unfairness', especially if it can be shown that the over-inclusiveness has caught a situation that may be said to lie outside the range of the underlying purpose.[1]

These subtle qualifications are not easy to represent comprehensively without creating a complex frame model in which individual control patterns are difficult to follow. Nevertheless, it was found that a basic provision had to be included to enable certain of the

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1 The definition of 'maisonette' has been found to be too narrow in some cases and the arguments quoted in Case 1 in Appendix A show how it can effect interpretation of a regulation

disputes reported to be adequately portrayed. The final template attempts to supply a sufficient framework on which to attach successive layers of information with enough sophistication to delineate the main issues raised by Schauer.

Considering the inter-relationships between regulations, rules, and norms makes it clear that external to each set of regulations is a network of forces which have a bearing on the ways regulations impact on the section of society at which they are aimed. Despite involving weighty issues outside the scope of this dissertation it is clear that some provision is needed to ensure that influences external to regulations are not entirely discounted. Furthermore, there is clearly a need, when analysing regulations to signpost connections with enabling legislation in order to locate the particular pressures that justify the regulation. This has been done in the template through the context segment.

10.3.2 Roles of legislative authority and sanctions

The authority of law in creating the right environment for the efficient application of regulations is also discussed in Chapter 2. It is suggested that in relatively stable regulatory environments the force of law and the ability to demonstrate requisite authority is of less consequence in obtaining adequate compliance than the construction of the regulation. The tradition of working within a framework of regulations has been established for such a long time in the UK that authorities can have a reasonable expectation of general compliance[2]. This is perhaps less the case for new legislation, especially when it is of a controversial nature.

The enabling legislation authorising a body of regulations defines the sanctions that come into play if non-compliance of the regulations is proved. The operation of sanctions is

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2 Enquiries about the number of prosecutions under the Building Act to the Head of the Building Control section within the DOE revealed no known instances. In their view all enforcement was resolved by negotiation or by appeal to the Secretary of State. However it was pointed out that prosecutions would be carried out by the Local Authority for the area in which the perceived transgression occurred.

shown in the systems diagram, put forward in chapter 4, to be part of the compliance process. For this reason it is considered that the subject of sanctions falls outside discussions about the template in its present form and outside the current investigation into the internal workings of regulations. Although not explicitly stated in *The Building Regulations 1985*, the presence of some form of sanction, however remotely applied, is fundamental to the nature of a prescriptive rule. Restricting the current research to a single edition of regulations means that the link with sanctions is dealt with adequately for these purposes by the contextual connection established through the 'context' segment.

10.3.3 Effect of the Legal System on regulations

To locate the arguments about the feasibility of creating legally acceptable alternative representations of regulations in computer processible format the work of previous researchers in analysing aspects of the law and examples of legislation were explored in the third chapter. This showed the extent of earlier progress towards evolving concepts about internal structure of legal statement. The review found a general consensus about the existence of a two-part split for legal statements: the situational specification; and the response definition. In succeeding chapters it is shown that these headings can be used for classifying disputes and that the numbers which occurred under each heading were in the ratio of one to two.

10.3.4 A 'systems' view

The model presented in chapter 4 is based on a 'soft systems' approach to show the interaction between the most important elements of the Building Control system, the parties involved and to clarify discussion in subsequent chapters. Features of a situation giving rise to public concerns were classified as ' situational specification', and conditions required to offset perceived risks were labelled 'response definition'. The 'context' segment allows issues to be recorded dealing with public concerns and the role of the Secretary of State in instructing the DOE to create regulations.

10.3.5 The Building Regulations

The description of the chief characteristics of *The Building Regulations 1985* drew attention to the new approach embodied in the Approved Documents. These contain most of the details used to establish the generalisations and to define the exact values in the constraint mechanism. The aim of *The Building Regulations 1985,* as part of the Building Act, is to supply the underpinning objectives for each individual regulation clause, and to assist in shaping the content of the 'purpose' component.

Comparison with the different regulatory styles of Germany and France showed the differences in methods of control and, by implication, variations in techniques for fixing the situational specifications and response definitions. German building law appears to make use of the 'DIN' standards, whereas the French system transfers responsibility to constructors with importance based on damage insurance and as a result may be less concerned with the exact content of technical regulations.

The question of degree of precision within clauses is raised because settling on a suitable style of classificatory detail is thought to be a means of determining how a regulation will 'settle down' in practice. It is suggested by some that by deliberately avoiding too much detail, a new regulation can be tested against real-life situations to assess its impact. Speedy revisions can be made, if needed, to resolve any anomalies. This approach may account for the different degrees of specificity in the sections of *The Building Regulations 1985.* Although such variations may be intentional, they can be made more obvious by the use of the template to show up scope for further refinement in cases where there is over- or under-inclusiveness.

10.4 UNEVEN APPLICATION OF REGULATIONS

10.4.1 The initial proposition

In chapters 6 and 7, by examining a representative sample of reported disputes, the major reasons for regulations being applied unevenly were found to lie in the description of either:

a) the situation which triggers the application of the regulation, (the situational specification), or

b) the requirements to be met if compliance is to be assured, (the response definition).

Evidence for the location of the specific part of a regulation which lead to a dispute was obtained from documented decisions of the Secretary of State in cases of appeal, or in formal requests for determinations. However, in the second of these chapters, it was found that the real location of the item that had caused the reported disputes was usually at a deeper level than indicated by these general headings. The consequences of this were illustrated by the expanded example disputes quoted at the end of the chapter, and in chapter 9 with its supporting appendices.

10.4.2 Information from disputes

Chapter 6 described the kind of information which could be obtained from disputes and which could be used to help identify discrete elements of any coherent internal structure that might exist within regulations. Breaking down regulation clauses into grammatical entities showed the recurrence of features used to form the main parts of regulatory structure. The data from the Institute of Building Control used for exploring the nature of disputes gives carefully reasoned explanations regarding decisions, dealing with fine points of difference in interpreting particular regulation clauses. An unexpected result of this

analysis was the large proportion, (over a third) which stemmed from disagreement about whether or not the regulations should apply to a given situation.

Examples of the kind of information pointing to identifiable constituents were: how appeals regarding 'invalidity pensions' emphasised the role of the situational specification; the debate about the deliberate entrenchment of the meaning of 'over'; and how a clear grasp of 'purpose' could help to determine the meaning of a regulation. Each case revealed something about the make-up of that particular regulation and the component responsible for the dispute. Comparison between a number of reports of disputes helped to clarify the sort of data that could be obtained by this process.

10.4.3 Causes of difficulty in applying Regulations

The methods used to scrutinise the circumstances identified by the previous chapter in more detail by evaluating the underlying causes are described in Chapter 7. They were found to be: incomplete definition; links with other documents; language; and changes to the circumstances that led to the creating of the regulation. The process of more thorough examination helped to determine the precise source of each disagreement. In this way, it became evident that an extra layer of information was present which supported the arguments of Schauer regarding entrenched generalisations.

10.5 THE UNDERLYING STRUCTURE AND CONSTRAINT MECHANISM

10.5.1 The second proposition

This proposition suggests that a systematic procedure for the analysis of regulations could be developed from understanding the internal structure of regulations. This has been shown in typical examples from *The Building Regulations 1985*, which confirm that analysis of regulations by means of a template can be based on a thorough understanding

of the internal structure of regulations. This is explained fully in chapter 9.

In chapter 2, the description of a prescriptive rule assumes that all components of a regulation will have some sort of generalisation attached to them and that this will have become entrenched. The template provides for this property of entrenchment to be identified from commentary on disputes or from empirical knowledge about the subject being represented. In addition, provision is made in the model to trap the most obvious occurrences of inclusiveness where they occur. The model also addresses Schauer's point about the influence of particularisation in determining whether a rule under consideration dissolved at the point of application. This is done by making it clear how much of a change to the regulation results from intervention by the Secretary of State. This may assist in deciding how much the rule or regulation has been 'bent' to accommodate a given situation.

Extra information about the characteristics of the component, which has been at the heart of a dispute, helps in tracing any relationships between the disagreements and the original purpose.

It is envisaged that recognising the internal structure of regulations will throw extra light on the questions raised by Cotterrell about regulatory style and referred to in chapter 3 by permitting comparative study of alternative sets of regulations. In part, the 'concerns' slot within the 'context' segment has catered for this by giving a 'hook' for future expansion. A higher-level frame would be required to record information about the legislative antecedents where more than one set of regulations is being compared

10.5.2 Determinations and case histories

In chapter 6, reports of Appeals and Determinations is seen as equivalent in many ways to the function of case law in adding to our understanding about the application of *The Building Regulations 1985.* In putting forward this view we can compare the structural concepts developed with the approaches of Gardner and Schild. The initial outline of the

template relies heavily on the arguments put forward in chapter 6, and the final arrangement of the template was obtained by extending the lines of enquiry examined at that point.

Chapter 7 explains the reasons for providing qualifiers for each component within a regulation frame. The aim is to make it possible to record extra levels of emphasis or special meanings that have become attached to particular words or phrases. To some extent this goes towards reducing the degree of open texture of the language used to express the regulation. This technique might also help to track changes to the accepted technical meaning acquired by words over time.

Because the process simulates the application a legal rule to a case the template approach in a modified form might be suitable for comparing the outcome of litigation in more general legal cases.

10.5.3 Context of regulation clauses

It became apparent that an additional segment was needed to record the contextual connections as a result of investigation into the ways in which language complicated the operation of regulations. Some assistance in interpreting the meaning of parts of regulations may be obtained by including the appropriate references within the frame for the 'context' segment. This segment is also used provisionally, to locate the links with the external legal environment. As has already been pointed out, to handle this matter adequately, a superior level of frames would be required to trace the nature of links when comparing sets of regulations.

10.5.4 The mechanism for applying constraint

The constraint mechanism is the component of the response definition, which had to be expressed in a different format to the other components of the regulation. This section of the internal structure has been separately distinguished because of its different composition

and its key role in determining the effect of the regulation. The form taken by the constraint is shown to have three distinct levels giving increasingly definite limits. It is necessary to express the levels in a modified frame format to distinguish between each of the three versions.

Extracting the constraints for comparison shows that the character of a regulation clause is governed by the extent to which the boundary limits are given in quantitative terms.

10.5.5 The result of applying the regulation template

Results show that the form of the internal structure recurs consistently throughout *The Building Regulations 1985*. No clause was found which could not be represented comprehensively by this means. The location of the item causing the dispute was identified in all disputes examined.

10.6 REPRESENTING REGULATIONS IN COMPUTER PROCESSIBLE FORMAT

10.6.1 The third proposition

In chapter 3 three issues were identified as bearing on the use of computer methods for processing regulations: rule status; distinction between hard and easy cases; and open texture of legal statements. Discussing rule status involves many complicated issues of general law, which are controversial and as such considered to be outside the scope of this dissertation. However, tracing different degrees of particularisation by employing an understanding of internal structure of regulations may help to clarify some aspects of the issue of rule status that underlies many legal positions. There is a similar sort of boundary between the original justification for a rule and its implementation, and the distinction between hard and easy cases. Both phenomena can be discussed with greater precision

when looking at specific cases but are elusive when trying to establish general rules about their distinguishing characteristics.

Several commentators on legal matters put forward the view that open texture is an inevitable aspect of natural language. It has already been mentioned that the proposed template attempts to address this issue through the use of qualifiers, which can be traced to current accepted practice or to interpretations given by the Secretary of State. Gardner's work dealing with contract case law was found helpful in suggesting methods for reducing descriptions of legal situations into small units for computer processing. It is possible that further work on analysis of more general legal statements and case law will reveal similarities with the internal structure of regulations.

This dissertation suggests that the exposure of the various components of the regulation combined with an agreed knowledge of the function of each increases our understanding of the workings of regulations in general. Furthermore, this form of analysis is helpful in interpreting the aims and requirements of individual clauses.

Use of the template approach shows directly where a regulation has gaps or potential weaknesses making it easier to identify the impact of new circumstances that may require changes to the legislation.

This approach can be computerised with beneficial results which both speed up processing and enforce a rigorous approach to analysis.

10.6.2 Regulations in frame-based format

Results from the use of the frame-based program are described in chapter 9 to illustrate how the issues addressed by this dissertation are dealt with and to show the significance of the findings of the research by comparing examples of the regulations with recorded disputes. The final form of the template is described to explain how it reflects the framework implied by the internal structure. The chapter concludes that testing the

template by representing regulations and related disputes demonstrates the proposition that regulations taken from *The Building Regulations 1985* have a consistent internal structure.

10.6.3 Regulations in design

The influence of regulations in the design process was briefly mentioned in chapter 2. The situational specification determines whether or not a regulation is applicable. However, the principal element of the internal structure that directly effects the design of buildings is the constraint mechanism, which is a factor in defining the solution space in which acceptable proposals will be situated. It can also provide a focus for searching the database to collect relevant conditions limited by the regulations. The list produced of response definitions would bring together those issues to be resolved by the designer.

By reference to the model put forward from a systems point of view, it can be seen that exposing the internal structure should, in future, make it easier to be definite about those points within a regulation that are affected by any pressures that arise for revision. This dissertation has been confined to *The Building Regulations 1985 so* that the influence on the internal structure of regulations by different styles of regulation can be ignored. Investigating how and when pressures for changing a regulation take effect by tracing the transformations through the use of the template approach should provide useful information for drafters of regulations.

10.6.4 Alternative representational techniques

In chapter 8, techniques for modelling legal statements are compared to review progress in this field and to take into account the complications introduced by analysis of language and legal statements. The final form that was determined for expressing the internal structure was arrived at after consideration of several different methods and data structures. The most relevant possibilities investigated are described to show the criteria used in making the selection. Early experiments with database retrieval techniques and

expert systems are described to identify which aspects of those techniques were relevant to the analysis of regulations. Fuzzy logic is an example of a method that appears to have relevance to dealing with problems of natural language like open texture. However, as stated in the section dealing with Artificial Intelligence tools in chapter 8, researchers have found few benefits in applying this method to address legal problems where open texture is a major issue.

It should be stressed that the eventual form of the template could have been detected using manual methods. Nevertheless, apart from the much greater amount of time involved it is likely that important relationships might have been missed due to the difficulty in processing large amounts of data manually. A feature of the frame method used is the provision for inheriting properties both upwards and downwards through the links of the complete structure. This avoids recording identical data more than once and facilitates collecting together regulation components or clauses sharing the same property or properties. In this way analysis is greatly simplified.

The original intention was to provide a user interface that parsed the actual regulation statement. It became clear from the early trials reported, that a measure of pre-processing was inevitable because of the need to invoke sections of the Approved Documents and related text. It also became clear that a parsing routine would offer little additional substantiation of the structure proposed and be dependent on an extensive lexicon of agreed terms before experimenting with various parts of the structure. However, experiments in the Prolog environment with the DCG[3] mechanism implied that the template could be adapted in future as a basis for constructing an adequate grammar for such a parsing process. It is difficult to see how extensive pre-processing could be avoided before using such an approach because of the need to reference numerous documents to achieve a satisfactory representation of the generalisations and entrenchments.

10.6.5 The final template

The final version of the template is described in detail in chapter 9. It is shown how this can represent clauses from *The Building Regulations 1985* using the selected edition of those regulations. The three highest level elements, the segments, are termed: context; situational specification; and response definition. Their role is explained by describing their configuration. Each segment contains specialised components that are qualified to varying extents depending on the requirements of the clause being analysed. The different segments have functions that ensure the regulation's completeness. The *context* ties the regulation back to its original justification and to linked recommendations referred to by the regulation. The *situational specification* describes the set of conditions that, if they exist, require appropriate actions within prescribed limits. In some cases, such as regulation B1, the situational specification is effectively repeated with just minor changes to allow for a series of similar conditions. In B1, introducing different sub-domains does this. The effect of this approach is to bring together closely related sets of circumstances that call for the same, or similar, precautionary measures. The *response definition* clarifies the characteristics of these measures and sets the limits for an acceptable way of dealing with the concerns raised by the circumstances envisaged.

10.6.6 Setting limits through the constraint mechanism

Arriving at a representation of the internal connections inside a regulation led to isolating the component at its core. This led to the second notable finding of this research - that it is *the* constraint component, which is the executive part of each clause of a regulation. Its task is to set the exact limits to meet the intentions behind the original justification for the body of regulations or the regulation of which it is a part. It is the point at which decisions

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3 Declarative Clause Grammar, a feature of most implementations of Prolog

about risk made by the drafter of the regulation are balanced against possibilities of non-compliance.

It is found that there are *three* different degrees of constraint setting increasingly precise limits: requiring the provision of a defined entity; requiring the entity to have a defined feature; or requiring the feature to have an attribute with values between defined boundaries. Each variation of the mechanism exerts a different level of restriction, from the straightforward demand for some entity to be present, through to setting limits on values of a required attribute of a prescribed feature.

The significance of the constraint mechanism is of particular interest because of its potential relevance for supporting research in constraint programming techniques. In view of the current level of interest in the various forms of Constraint Logic Programming, it would seem likely that there will be increased appreciation, in the near future, of the way in which the interaction of the web of constraints operates upon a given set of conditions. This development may give valuable insights, not only into selection of appropriate strategies for regulation in particular circumstances, but also into design and decision making activities. Constraint programming is becoming established as a separate discipline, though mainly focused on problem-solving techniques. At some point ideas generated in this field should have a direct relevance to the action of constraints within a regulatory environment.

In the query mode, regulations can be displayed with or without qualifiers for a quick overview or more detailed examination. The qualifiers may be inspected separately by invoking Prolog queries to find out the range of their influence by comparing their role in modifying similar component, say the 'topic' or 'sub-domain'.

10.7 LIMITATIONS OF THE RESEARCH

Focusing, as it does, on only one body of regulations and its related compliance process, the current study is inevitably limited in its authority and the model may have been inadvertently influenced by the chosen method of computer modelling. The extent of pre-processing is a further source of variability because personal judgements have been involved in converting the original form of the regulation into a series of words or phrases suitable for entering into the computer.

From what has been said in earlier chapters it is clear that there are different styles of regulations and attitudes to enforcement. To confirm the form of the internal structure by comparison and to strengthen the concept of the template further investigation is needed with other bodies of regulations.

In addition to testing the template by analysing other sets of regulations consideration should be given to the relationship between these forms of regulation and methods used to obtain compliance. This should help us find out more about how the various forces that are involved in creating and administering regulations are reflected internally within the regulation.

Additional problems are created by the restrictions involved in using a fairly primitive computer model. More work needs to be done on improving the interface for the uninformed user to enable the process to be tried by persons unconnected with the original theory. Furthermore, it would be helpful for a vocabulary to be developed as an extension of the systems model, to ensure greater precision when discussing the process of regulation.

10.8 FURTHER RESEARCH

10.8.1 Testing and data extraction

Using the template as a starting point, a most important step in continuing this line of research into regulatory will be to carry out a programme of tests based on the proposals set out at the end of chapter 9. Tests could, for example, be employed to validate the proposition that the template can be applied in endeavouring to predict the outcome of disagreements about the application of individual regulations.

If the template form then achieves general acceptance it could be used as a basis for application for knowledge engineering programmes - e.g. for processing regulations as an input into building knowledge bases and for extracting quantitative constraints to load rule bases controlling computer programs.

10.8.2 Different regulatory processes

The conclusions of chapter 5 imply that some research into ways of assessing the performance of regulations against their original justification might increase our awareness of the influences generated by varying regulatory styles.

Another obvious area for further research is suggested by the weakness mentioned above in ignoring other regulatory environments. An example of the potential significance of different regulatory processes is in the area of mobile telecommunications. There, the need for regulation is a result of the change of the market from one of state control to one of enforced competition. A quite different approach to obtaining control is through licensing agreements. There are suggestions[4] that the form of regulation imposed through the granting of licences has strengthened the monopolistic framework. It seems that the

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4 Interview with Telcom, consultants in the regulation of the telecommunications market.

projected target condition, of three or more effective suppliers in the market place, has yet to be achieved. The current situation is such that the cost of market entry has proved an obstacle to achieving the make up of the market that was originally planned. Market forces have created a situation that stands in the way of conditions arising that meet the situational specification. As a consequence the regulations are not invoked and fail to stimulate competition.

10.8.3 Superior legislation

More work is needed to refine and extend the link to superior legislation to facilitate richer connections with enabling or parallel legislation, and to the political and social forces behind the creation of regulations.

Fields for further research are suggested by the possibilities for comparative analysis. As an example, a list of response definitions can be derived from different sets of regulations to look for overlapping areas of control. A second line of enquiry would be to assess how the operation of sanctions may be linked to the contextual connections identified in the 'context' frame.

10.8.4 Compliance regimes

The compliance process was excluded from the investigations because the model showed a distinct boundary between that section responsible for providing regulations and that dealing with compliance. An examination of the various types of boundary setting in different regulatory environments could be of assistance to those responsible for drafting regulations.

10.8.5 Regulation language

A further opportunity for extending the research would be to attempt constructing a regulation 'language' or logic to support discussions about the operation of regulations and

for extending the current findings. Perhaps the largest grey area within this subject is the connection between the purpose of the regulation and its eventual form. There is some evidence that methods used to draft regulations are to a certain extent a compromise and cannot ensure a clear relationship with the original justification.

Twinning and Miers have explored this in some detail in the case of 'the legalistic child', pointing to the wide discrepancies that can arise in even the simplest situation. Another third question to be considered is the relationship between the process of specifying the situational specification and the response definition. There is a link with classificatory techniques and the problems of open texture caused by natural language. A possible way of tackling this is for the computer program to give an ability to expand specifications having due regard to the context of the regulation. The development of an agreed 'language' would greatly assist interpretation within defined domains.

10.8.6 Constraint formulations

Additional research is also suggested by the emergence of the constraint mechanism as a discrete component of regulations. The first of these is continued investigation into constraint analysis and possibilities for their extraction to be used in decision support software. This should lead to evaluating the extent to which knowledge is entrapped and accessible from within regulations as a record of our technical advance. It would also give us a mechanism from which we can access earlier decisions as changes occur. Schauer has made the point that regulations are ways of structuring the future and it could be interesting to have the opportunity to audit this process in a structured manner.

710.8.7 Case law similarities

The work of Gardner and Schild has indicated a way forward in achieving intelligent access to the contents of case law decisions. Further progress might be possible by investigating the application of a form of template similar to that adopted for representing

regulations. Determinations by the Secretary of State can be regarded simplistically as equivalent to decisions of the courts.

10.8.8 Object oriented programming and other computer languages

The Prolog programming language provides many of the features of object oriented languages. However, it has shortcomings. Newer versions may remove some of the limitations experienced in the implementation on which this work is based. Other languages may accelerate development to establish more exact and traceable connections to the original text and improve the results of computer processing.

10.9 SUMMARY

The results of this research support the proposition that representing regulations in a form that reflects the existence of their internal structure, will ensure that essential characteristics become more accessible. This technique for representation should simplify comparison between different forms of regulations and between the components from which they are assembled. This will provide a basis for checking their completeness and facilitate updating. The process should also support research into further aspects of the operation of regulations and perhaps into the wider area of rules in general. The implications for risk based decision making are that decisions regarding regulations can be made auditable thereby improving performance evaluation.

10.9.1 Experience of varying standards in the application of regulations

In the introductory chapter it was stated that the research was prompted by bewilderment in trying to obtain agreement regarding the impact of various regulations in the construction industry over more than two decades. Contact with other professionals over that period showed that this is the usual experience.

The process of obtaining agreement between applicant and the Local Authority is usually part of a discussion about a number of points involving trade-offs and negotiation. Eventually, one or two sticking points are left and it is in these situations that a framework for breaking the contentious regulation would be most helpful. Both sides are usually keen to resolve the matter to save time and expense but find it difficult to find common ground over a small point of detail. In such circumstances, knowledge, real or assumed, of the precise meaning to the regulation concerned places power in the hands of the party concerned and can be telling in deciding the outcome of the negotiation.

10.9.2 Arriving at a consensus about the salient aspects of a dispute

A format has now been found which represents the construction of regulations in sufficient detail to expose the finer points of carefully argued differences about their application. This process produces consistent results and can be used to trace back from the original wording of the regulation to its supporting documents and related legislation. One of the benefits of basing research on the particular body of regulations chosen is the extensive knowledge and written commentaries that have accumulated over the years dealing in minute detail with the subject matter.[5]

A developed version of the template can therefore be a useful tool in helping disputants clear away extraneous aspects of a regulation clause to focus on the essential point of difference. Presenting regulations in what amount to a fully annotated form, would provide extra information about the components giving both sides access to complete information about each clause thereby reducing room for misunderstanding. Since both sides can be expected to seek an early resolution to the disagreement, identifying the exact content of their differences should save time and avoid unnecessarily long negotiations.

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5 Of special relevance has been the reports of Selected Appeals and Determinations published by the Institute of Building Control.

However it should be noted that interviews with academics concerned with regulation processes have indicated that there are many other styles of regulation, which may involve templates having differences in format. It would be of special interest to discover the effect of alternative compliance processes on the form of the template.

10.9.3 The role of experience in the research

It was stressed that the author's long experience of applying the building regulations provided an important framework for the analysis. Familiarity with the terminology and access to relevant publications through knowledge of their subject matter played a vital part in dissecting each clause. In view of the role played by the author's specialist knowledge, it must be emphasised there is nothing automatic about the process of analysis used to arrive at the final results.

However, having used this knowledge to look for and identify the internal structure, it is possible that future researchers into parallel regulatory regimes would need less industry-specific expertise. This could be investigated by involving a number of professionals from the construction industry in a project to compare their results of modelling regulations using the methods proposed in this dissertation.

APPENDIX A

Examples of Dispute Analysis

APPENDIX A EXAMPLES OF DISPUTE ANALYSIS

The examples that follow concentrate mainly on the regulation responsible for the bulk of reported disputes in the target group. This is the report of the Appeals and Determinations published by the Institute of Building Control for the year 1989.

C1 CASE 23 - B1 (SUB-CLAUSE (a)ii OF THE LIMITATIONS)

C2 CASE 54 - B1 (SUB-CLAUSE (b) OF THE LIMITATIONS) AND APPENDIX B

C3 CASE 55 - B1 (SUB-CLAUSE (a)ii OF THE LIMITATIONS)

C4 CASE 66 - B1 (SUB-CLAUSE (a)ii OF THE LIMITATIONS)

C5 CASE 80 - B3 (2)

C6 CASE 115 - G4 (2)

C7 CASE 129 - K1 (SUB-CLAUSE 1.4 OF THE APPROVED DOCUMENTS)

C8 G1 SUB-CLAUSE a (alternative derived from regulation)

C1 CASE 23 - B1 (SUB-CLAUSE (a)ii OF THE LIMITATIONS)

introduction

This example was selected because it illustrates the way in which a related set of recommendations referred to in the context influence the application of the situational specification.

limits on application

"1. This requirement applies only to -

(a) (ii) contains a flat and is of three or more storeys,

program output

SECTION, REGULATION NUMBER and SUB-CLAUSE: B1 (1) (a)ii

The CONTEXT of < means_of_escape_fire_flats > is:

references: **bRegs85_mandatory_rules, bsCP3_ch4_pt1**
generalisation .. mandatory_rules, flats_and_maisonettes
entrenchment .. fire_escape_regulations
inclusiveness .. under
concerns : **death_or_injury_from_fire**
generalisation .. suffocation,burning,collapse

comment - Standard context derived from the general definition of the regulation with the addition of the reference to the Code of Practice.

SITUATIONAL SPECIFICATION for < fire_precautions_flats > is:

domain : **buildings**
generalisation .. permanent,temporary,part,over_2_storeys
entrenchment .. with_roof_and_walls
inclusiveness .. under
qual .. is_erected
subdomain: **contains_flat**
generalisation .. separate_self_contained_dwelling,
part_of_building, horizontally_separated
topic : **in_case_of_fire**
generalisation .. combustion
entrenchment ..permanent_fire_risk

comment - Standard 'domain' and 'topic' derived from the general definition of the regulation. The sub-domain limits the application of this clause to three storey buildings containing flats.

components of RESPONSE DEFINITION are:

purpose : **safe_escape**
generalisation .. rescueable
entrenchment .. within_30_mins
inclusiveness .. under
entity : **means_of_escape**
generalisation ..[safe_route,structural, from_any_point_in_building]
entrenchment .. protected
inclusiveness .. over
qual .. to_place_of_safety_outside

comment - Standard response definition derived from analysis of the general regulation B1.

CONSTRAINT: entity shall have bounded feature: capable_of_being_used
generalisation .. without_assistance
entrenchment .. by_ambulant_persons
qual .. safely_and_effectively
lower bound: **at_all_material_times**
generalisation .. none
entrenchment .. continuously
inclusiveness .. over
upper bound: **no_max**
generalisation .. _upper_limit

comment - Standard constraint limits derived from analysis of the general regulation B1.

report

In this case "....the applicant stated that in their opinion CP3 Chapter IV Part 1 1971 did not apply to the type of dwelling under consideration but nevertheless sought relaxation of Requirement B1. The Council refused to relax.

In support of their appeal, the applicants stated that the maisonette was of two storeys entered from the ground level and thus outside the scope of CP3 Chapter IV. They also stated that in any case the recommendations of paragraphs 3.2.3.1 and 3.2.3.4 other than for means of escape has been met. A further point made was that identical units have been approved by at least five other local authorities.

The Council's case was that the units were three storeys high and came within the scope of CP3 Chapter IV. 'Assisted' escape was not possible due to the height of the building and some units did not have a window available for egress...

The Secretary of State in his decision sated that the building type was of three storeys and has a flat at ground storey and a maisonette on the first and second storeys. Part B1 applies only in respect if the occupants of the top storey of the maisonette. In the maisonette there was a bedroom on the top storey and that room was open, via a void, tot living/dining room a the lower level... A kitchen opened into the living/dining room but it was separated from the latter by a fire resisting and self-closing door.

Egress from the second floor was direct into a stairway that was protected by fire resisting construction from the rest of the dwelling. The stairway discharged direct to outside at ground level. The travel

distance from any point in the second floor bedroom to the comparative refuge the protected stairway was short.

The relevant code (CP3 Chapter IV Part 1) called up in the mandatory rules is not written with this type of dwelling in mind. Indeed, dwellings of 'one or two storeys entered at ground level from outside any block .... are not included'.

Although the building was not specifically excluded from the scope of the code (because it was of three storeys and the scope only excludes certain one or two storey flats) the recommendations in the code need to be applied in a very flexible manner.

In the circumstances it was considered that the means of escape in the event of a fire available to persons in the second store was of a reasonable standard, notwithstanding that it did not meet the recommendations in the code of practice called up by B1. The Secretary of State therefore allowed the appeal.

summary

The location of the dispute is entirely in the references component of the context of the regulation. The role of context in sharpening the focus of the situational specification is emphasised by this case.

The 'Mandatory Rules' are linked to the Code of Practice by the directions given in Section 2. The Secretary of State's commentary adds further insight to the kinds of characteristics that should be associated with the interpretation of the difficult term 'maisonette'.

This is an example of a decision could be cross referenced by a sophistication of the Prolog programme to record the development of the regulation by reported disputes.

C2 CASE 54 - B1 (SUB-CLAUSE (b) OF THE LIMITATIONS) AND APPENDIX B

introduction

This example was selected because it shows how a very specific definition of a response definition that is deemed acceptable can omit a set of conditions that occur fairly frequently. The illustration that forms part of Appendix B of the 'Mandatory Rules' shows only a section through pitched roofs whereas many loft conversions are made in a roof which has a gable wall. In such a situation the gable wall is often a more acceptable position for a window and can avoid hazards associated with the small section of sloping roof above the gutter line.

limits on application

"1. This requirement applies only to -

(b) a dwelling-house which is extended or materially altered and will have three or more storeys. (the response definition is modified in terms of the constraint by Appendix B of the 'Mandatory Rules')

program output

SECTION, REGULATION NUMBER and SUB-CLAUSE: B1 1(b) Appendix B
(required to uniquely identify this version of the regulation)

CONTEXT of < means_of_escape_fire_loft_conv > is:

references: **bRegs85_mandatory_rules,bS5588_s1**
generalisation .. mandatory_rules, cp_single_family_dwellings
entrenchment .. fire_escape_regulations
inclusiveness .. under
concerns : **death_or_injury_from_fire**
generalisation .. suffocation,burning,collapse

comment - The segment above is inherited from the general clause and was not disputed in this appeal.

SITUATIONAL SPECIFICATION for < fire_precautions_loft > is:

domain .. **building**
generalisation .. permanent,temporary,part,over_2_storeys
entrenchment .. with_roof_and_walls
inclusiveness .. under
qual .. is_erected
subdomain .. **loft_conversions**
generalisation .. one_or_two_habitable_rooms
entrenchment .. in_roof_space
inclusiveness .. under
qual .. new_storey

topic .. **in_case_of_fire**
generalisation .. combustion
entrenchment .. permanent_fire_risk

comment *'Domain' and 'topic' are also inherited from the general definition of regulation B1 but this segment is different in the definition of the sub-domain. This makes provision for the special case dealing with minor works within the roof-space of dwellings and where there are one or two habitable rooms in the new storey. This segment was not disputed, but is responsible for triggering the relevant response definition.*

characteristics of RESPONSE DEFINITION are:

purpose .. **safe_escape**
generalisation .. rescueable
entrenchment .. within_30_mins
inclusiveness .. under

entity .. **means_of_escape**
generalisation .. safe_route,structural, from_any_point_in_loft
entrenchment .. protected
inclusiveness .. over
qual .. to_place_of_safety_outside

comment *The definition of 'purpose' and 'entity' is inherited from the general definition of regulation B1.*
For works involving loft conversions the constraint imposes special limits tailored to the constructional and spatial characteristics of such situations.

CONSTRAINT:entity shall have bounded feature: useable, fire_door_protection, escape_windows

comment - *There are three features that are bounded by the regulation; usability, fire door protection and provision of escape windows. The first of these is taken from the general definition. Details of the second and third are set out in Appendix B to the Mandatory Rules. For convenience the three bounded features have been combined whereas the Prolog processor handles each by generating three different regulation definitions. In this case it is the definition of the escape window that is the focus of the dispute.*

useable:
generalisation .. without_assistance
entrenchment .. by_ambulant_persons
qual .. safely_and_effectively
lower bound: **at_all_material_times**
generalisation .. none
entrenchment .. continuously
inclusiveness .. over
upper bound: **no_max**
generalisation .. no_upper_limit

fire_door_protection

generalisation .. fire_resisting_enclosure,self_closing
entrenchment .. half_hour
inclusiveness .. over
qual .. to_BS476_part8

lower bound: **all_doors_to_enclosure**
generalisation .. none
inclusiveness .. over

upper bound: **no_max**
generalisation .. no_upper_limit

escape_windows

generalisation .. **window_as_illustration**,rooflight
entrenchment .. openable
inclusiveness .. over

lower bound: **no_min**
generalisation .. only_maximum

upper bound: **cill_max_1100**
generalisation .. to_bottom_of_opening
entrenchment .. from_floor_level
inclusiveness .. over

comment - *The essential point here is that the focus of dispute is contained in the generalisation derived from the appendix at the back of the 'Mandatory Rules'.*

report

" The Secretary of State took the view that he was being asked to determine, under Section 16(10)a whether plans of the proposed work were in conformity with paragraph B1 of Schedule 1 of the Building Regulations 1985 in respect of the means of escape provided by a window in a gable wall.

The applicant stated that the proposed alternative means of escape was a window in a gable wall. It would be at least 850mm high and 500mm wide and the bottom of the opening would be less that 1.1m from the floor level. The proposal therefore followed Appendix B of the 'Mandatory Rules for means of escape in the case of fire'.

The local authority stated that the proposal did not conform with Appendix B. The proposed window would not be in a pitched section of the roof close to the eaves, so it would no be positioned as shown in Figure 1 of Appendix B.

The Secretary of State noted that the proposed window met the dimensional constraints of Appendix B and that there was sufficient room at the side of the house to allow placement of a ladder. He took the view that 'positioned as shown in Figure 1 of (Appendix B para 9) does not exclude a window in a gable. In the context of paragraph (g) Appendix B, a window such as that proposed is an acceptable alternative to a dormer window or a window in the roof slope.

summary

The decision of the Secretary of State that a window in a gable wall is a simple extension of the drawing in Appendix B which only shows a section through a window in the roof. The effect of his decision was to extend that set of criteria forming part of the generalisation applying to the description of the controlled entity to include the situation proposed.

C3 CASE 55 - B1 (SUB-CLAUSE (A)II OF THE LIMITATIONS)

introduction

This example was selected because it reveals the possibility for dispute on even the most fundamental sections of a regulation. The 'Mandatory Rules' rest on the basis that buildings over two storeys require safe means of escape. Here is a situation in which the Secretary of State creates an exception based on the fact that the middle storey provided direct access to the ground because of ground levels.

limits on application

"1. This requirement applies only to -

(a) (ii) contains a flat and is of three or more storeys,

program output

SECTION, REGULATION NUMBER and SUB-CLAUSE: B1 (1) (a)ii

The CONTEXT of < means_of_escape_fire_flats > is:

references:	**bRegs85_mandatory_rules**		
		generalisation ..	bRegs85_mandatory_rules, bsCP3_ch4_pt1
		entrenchment ..	fire_escape_regulations
		inclusiveness ..	under
concerns :	**death_or_injury_from_fire**		
		generalisation ..	suffocation,burning,collapse

comment - *Standard context derived from the general definition of the regulation.*

SITUATIONAL SPECIFICATION for < fire_precautions_flats > is:

domain :	**buildings**		
		generalisation ..	permanent,temporary,part,**over 2 storeys**
		entrenchment ..	with_roof_and_walls
		inclusiveness ..	under
		qual ..	is_erected
subdomain:	**contains_flat**		
		generalisation ..	separate_self_contained_dwelling, part_of_building,horizontally_separated
topic :		**in_case_of_fire**	
		generalisation ..	combustion
		entrenchment ..	permanent_fire_risk

comment - *Standard 'domain' and 'topic' derived from the general definition of the regulation. The sub-domain limits the application of this clause to three storey buildings containing flats.*

components of RESPONSE DEFINITION are:

purpose : **safe_escape**
- generalisation .. rescueable
- entrenchment .. within_30_mins
- inclusiveness .. under

entity : **means_of_escape**
- generalisation .. safe_route,structural, from_any_point_in_building
- entrenchment .. protected
- inclusiveness .. over
- qual .. to_place_of_safety_outside

comment - *Standard response definition derived from analysis of the general regulation B1.*

CONSTRAINT: **entity shall have bounded feature: capable_of_being_used**
- generalisation .. without_assistance
- entrenchment .. by_ambulant_persons
- qual .. safely_and_effectively

lower bound: **at_all_material_times**
- generalisation .. none
- entrenchment .. continuously
- inclusiveness .. over

upper bound: **no_max**
- generalisation .. no_upper_limit

comment - *Standard constraint limits inherited from analysis of the general regulation B1.*

report

" The applicant proposed to convert a barn into three holiday units. The dispute with the Council concerned the middle unit, which was to have three storeys. He claimed that the bottom storey was a basement and that Part B1 did not apply to the unit since buildings of two storeys with a basement do not have to comply with this requirement. The Council viewed the proposal as a three storey building to which B1 applies. The Secretary of State took the view that the lowest storey was not a basement since the highest ground adjacent to the building was not more that 1.2 above the bottom storey floor (although the proposal intended an outside platform on the middle storey level, directly accessible by a door). However, in view of the fact that final exit could be made from the door in the middle storey, he considered that the means of escape was not significantly worse than it would have been in a have two storey building. He determined that Part B1 was met by the proposal.

summary

The location of the dispute is in the domain component of the situational specification of the regulation. The particular role of components of the situational specification in triggering the application of the regulation is demonstrated by this case. It should be noted that in this case the Secretary of State did not agree that the lower storey was a basement. Nevertheless, he took account of special conditions that modified the response required after it was acknowledged that there was a requirement for a means of escape.

C4 CASE 66 - B1 (SUB-CLAUSE (A)II OF THE LIMITATIONS)

introduction

This example deals with the comparison between two sub-clauses of the regulation that are called into effect by the 'limitations'. The version of the regulation that is used to illustrate the dispute stems from the most expected interpretation of the regulation and one which has been separately held to apply since this case was reported. Reference to the fully commented version of the alternative is given under Case 2.

limits on application

"1. This requirement applies only to -

(a) (ii) contains a flat and is of three or more storeys,

program output

SECTION, REGULATION NUMBER and SUB-CLAUSE: B1 (1) (a)ii

The CONTEXT of < means_of_escape_fire_flats > is:

references:	**bRegs85_mandatory_rules**	
	generalisation ..	bRegs85_mandatory_rules, bsCP3_ch4_pt1
	entrenchment ..	fire_escape_regulations
	inclusiveness ..	under
concerns :	**death_or_injury_from_fire**	
	generalisation ..	suffocation,burning,collapse

comment - Standard context derived from the general definition of the regulation.

SITUATIONAL SPECIFICATION for < fire_precautions_flats > is:

domain :	**buildings**	
	generalisation ..	permanent,temporary,part,over_2_storeys
	entrenchment ..	with_roof_and_walls
	inclusiveness ..	under
	qual .. is_erected	
subdomain:	**contains_flat**	
	generalisation ..	separate_self_contained_dwelling, part_of_building,horizontally_separated
topic :	in_case_of_fire	
	generalisation ..	combustion
	entrenchment ..	permanent_fire_risk

comment - Standard 'domain' and 'topic' derived from the general definition of the regulation. The qualification that the building "is erected" is taken from Section 1 of the 'Mandatory Rules'.

components of RESPONSE DEFINITION are:

purpose : **safe_escape**
- generalisation .. rescueable
- entrenchment .. within_30_mins
- inclusiveness .. under

entity : **means_of_escape**
- generalisation .. safe_route,structural, from_any_point_in_building
- entrenchment .. protected
- inclusiveness .. over
- qual .. to_place_of_safety_outside

comment - *Standard response definition derived from analysis of the general regulation B1.*

CONSTRAINT: **entity shall have bounded feature: capable_of_being_used**
- generalisation .. without_assistance
- entrenchment .. by_ambulant_persons
- qual .. safely_and_effectively

lower bound: **at_all_material_times**
- generalisation .. none
- entrenchment .. continuously
- inclusiveness .. over

upper bound: **no_max**
- generalisation .. no_upper_limit

comment - *Standard constraint limits inherited from analysis of the general regulation B1.*

report

" The application proposed to carry out a loft conversion at second storey level in a building each of whose first two storeys were then self-contained flats with a common entrance lobby.

The Council has objected to the proposal under B1.

The Secretary of State noted that Part B1 has certain restrictions on its application. These exclude the building under consideration. Parts 1(a)(i) and 1(b) apply only to dwelling-houses. Parts 1(a)(ii) and 1(c) apply only to buildings which three storeys before proposed building work. Parts 1(a)(iii) and 1(iv) concern offices and shops. He therefore determined that the proposal was not in contravention of B1.

summary

The location of the dispute is in the domain component of the situational specification of the regulation. The particular role of components of the situational specification in triggering the application of the regulation is further emphasised by this case. The decision of the Secretary of State takes the words of the regulation and supporting 'Mandatory Rules' precisely at face value ignoring the presumed intention to ensure the provision of means of escape for all new living accommodation at third floor level.

C5 CASE 80 - B3 (2)

introduction

This example was selected because of the range of arguments presented focusing on the exact meaning of the sub-domain. The interest of this case is the way in which circumstances of the case are used to support the arguments of each side. As can be seen from the regulation wording quoted below, details of the sub-domain are not given in the actual regulation. For this reason, details taken from the Approved Documents are used to construct the full model to draw out the distinctions that are important to the decision of the Secretary of State.

the regulation

"B3. - (2) The building, or the buildings as extended, shall be sub-divided into compartment where this is necessary to inhibit the spred of fire within the building.

program output

SECTION, REGULATION NUMBER and SUB-CLAUSE: B3 (2)

The CONTEXT of < fire_resistance_of_structure > is:

references: **bs476_Fire_Tests**
generalisation .. part8_fire_resistance_of_elements
concerns : **risk_of_fire_spread,collapse**
generalisation .. entrapment

comment - *Standard context derived from the expanded version of the regulation taking into account the further stipulations contained in the Approved Documents.*

SITUATIONAL SPECIFICATION for < fire_protection_inst > is:

domain : **buildings**
generalisation .. permanent,temporary,part,over_2_storeys
entrenchment .. with_roof_and_walls
inclusiveness .. under
subdomain: **institutional**
generalisation .. **residence_for_persons_suffering_from_some_disability**,_or_under_5
topic : **structural_fire_resistance**
generalisation .. period_to_retain_integrity

comment - *Standard 'domain' and 'topic' are taken from the general definition of the regulation and taking into account the further stipulations contained in the Approved Documents. The sub-domain limits the application of this clause to very specific residential groups.*

components of RESPONSE DEFINITION are:

purpose : **maintain_str_stability**

generalisation .. avoid_premature_failure
entrenchment .. retain_strength_to_allow_escape, prevent_fire_spread
inclusiveness .. under

entity : **compartmental_elements**
generalisation .. frames,beams,columns,floors,galleries
entrenchment .. protected
inclusiveness .. under

comment - Standard response definition inferred by analysis of the general regulation.

CONSTRAINT: **entity shall have bounded feature:**
fire_resistance_boundary_elements
generalisation .. specified_min_period_of_fire_resistance
entrenchment .. table_A3_p42
qual .. safely_and_effectively

lower bound: **hours_1**
generalisation .. longest_period
entrenchment .. continuously
inclusiveness .. over

upper bound: **no_max**
generalisation .. no_upper_limit

comment - Constraint limits obtained from tables contained in the Approved Documents.

report

"The Secretary of State noted that the proposal was to extend an existing detached residence and carry out alterations to form a home for nine elderly people, five in first floor and four on the ground floor. The dispute concerned the standard of fire resistance provided by the floor between the ground and first storeys and that part of the flat roof which was part of the emergency means of escape from the first floor.

The Council considered that the building would be of institutional use and that the one hour fire resistance therefore should be provided. There were several reasons why they regarded the use as institutional. All the cooking and living arrangements were communal. The occupants would be elderly and were likely to stay in the home until hospitalisation becomes necessary and tow sanitary conveniences suitable for disabled people were to be provided for residents.

The applicant contended that the building will be of 'other residential' use and so only half hour fire resistance is specified in table 0.1 of Approved Documents B2/3/4. He pointed out that there were smoke detectors in every bedroom and communal room and that the office and staff accommodation would be occupied at all times. Despite the provision of toilets suitable for disabled people he stated that all the residents would be ambulant. The Secretary of State noted that Schedule 2 to the 1985 Building Regulations did not apply to this proposal. There will be no nursing facilities provided by the home.

The Secretary of State is of the opinion that implicit in the use of an institutional building is the provision of health care facilities and that old age is not in itself a disability. In this case there was no provision for medical care and so this building would be similar to any small hotel whose occupants could be elderly. He therefore considered that the proposed use of this building should be regarded as 'other residential'..."

summary

The key point in this case is the classification of persons for whom the building is intended. The designation of such users is given in the general table 0.1, which precedes the main section relating to B2/3/4. It describes 'Institutional' use as being for "hospital, home, school or other similar establishment used as living accommodation for, or for the treatment care or maintenance of, persons suffering from disabilities due to illness or old age or other physical or mental disability, or under the age of fire years, where such persons sleep in the premises. The intention behind wording of the definition for 'Institutional' depends on the occupants "suffering from disabilities", and that feature must be present for the regulation to apply.

C6 CASE 115 - G4 (2)

introduction

This example was selected because of the conflict between rejecting a solution that represented an improvement and the alternative that could lead to a reduction in the level of hygiene. The Secretary of State pointed out that rejecting the proposal would have gone against the purpose of the legislation.

the regulation

"G4. Sufficient sanitary convenience shall be provided which shall be -

(a) in rooms separated from places where food is stored or prepared; and

(b) designed and installed so as to allow effective cleaning

program output

For clarity, and to place the arguments of the Council the model which follows deals with the first clause only.

SECTION, REGULATION NUMBER and SUB-CLAUSE: G4(a)

The CONTEXT of < sanitary_accommodation > is:

references: **bs6465_pt1**
generalisation .. sanitary_appliances
extra_refs .. bAct84_s65,ph_Act36_s51, o_s_rway_prems_Act, food_hygiene_70_Regs

concerns : **personal_cleanliness,bacterial_spread**
generalisation .. physical_contact,inadequate_provision
entrenchment .. airborne_germs

comment - Context derived from further regulations quoted in the Approved Documents.

SITUATIONAL SPECIFICATION for < sanitary_provision > is:

domain : **buildings**
generalisation .. permanent,temporary,part
entrenchment .. with_roof_and_walls
inclusiveness .. under

subdomain: **elderly_persons_home**
generalisation .. home

topic : **sanitary accommodation**
generalisation .. toilet_appliances

comment - 'domain' and 'topic' taken from the general definition of the regulation and taking into account the further stipulations contained in the Approved Documents. The sub-domain is obtained from definitions in the British Standard which relates the application of this clause to specific groups of users.

components of RESPONSE DEFINITION are:

purpose : **hygiene**
generalisation .. reduce_risks_to_health_of_persons_in_buildings
inclusiveness .. under
entity : **sanitary_conveniences**
generalisation .. closets

comment - *Response definition taken from the notes following the regulation.*

CONSTRAINT: **entity shall have bounded feature: siting**
generalisation .. separation
lower bound: **separated_from_places_where_food_is_stored_or_prepared**
generalisation .. not_open_directly_into_proscribed_space
entrenchment .. provide_ventilated_lobby
inclusiveness .. under
upper bound: **no_max**
generalisation .. no_upper_limit

comment - *Constraint limits inferred from clause 1.5 of the Approved Documents.*

report

"The applicant proposed to install a toilet in each of two rooms occupied by elderly resident. The Council rejected the proposal on the ground that it did not comply with the guidance given in BS 6465 Part1:1984. The Secretary of State noted that two alternative for the siting of toilets are given in Approved Documents to G4. The applicant has complied with the guidance give in paragraph 1.5. The two rooms concerned would not adjoin rooms where food is stored or prepared, or washing-up done. The alternative approach commended by the Council is contained in paragraph 1.4, but as with all Approved Documents, the approach delineated there is guidance and not a requirement. He also noted that the toilets were being installed for elderly people who would otherwise require a bed-pan, chamber-pot or commode. He considered the proposal satisfactory from the perspectives o hygiene and ease of access. So he determined that G4 was met by the proposal."

summary

The Approved Documents state that "the requirement can be met, subject to other legislation by following the relevant recommendations of Clauses 2, 3 and 6 to 8 of BS 6465 *Sanitary installations*, Part 1: 1984 *Code of Practice for scale of provision, selection and installation of sanitary appliances"* as being an alternative to the stipulations of clause 1.5. The Council appeared to be relying on the wording of this last clause without taking into account the greater discretion allowed by the British Standard, which is less specific about direct separation.

C7 CASE 129 - K1 (SUB-CLAUSE 1.4 OF THE APPROVED DOCUMENTS)

Regulations dealing with design criteria for staircases, section K, have numerical limits set that are in themselves less controversial. Nevertheless, there is plenty of room for disagreements about the conditions that trigger their application. This example was selected because it has an overlap with Appendix B of the 'Mandatory Rules' which has been the subject of most of the other examples. It shows how the effect of one decision can impact on another part of the regulations.

regulation

K1. Stairways and ramps shall be such as to afford safe passage for the users of the building.

1.4 The steepness can be controlled by putting limits on the rises and the goings but limits should be also put on the pitch of stairs serving dwellings. These limits are:

- Private stairs 42 degrees.

program output

SECTION, REGULATION NUMBER and SUB-CLAUSE: K1 - AD1.4

CONTEXT of < stairways > is:

references: **bs5395**
generalisation .. part1_cp_stairs,amd3355,amd4450
concerns: **risk_of_falling**
generalisation .. safety_in_buildings

SITUATIONAL SPECIFICATION for < stairs > is:

domain: **buildings**
generalisation .. permanent,temporary,part
entrenchment .. with_roof_and_walls
inclusiveness .. under
qual .. is_erected
subdomain: **single_dwelling**
generalisation .. inc_dwellinghouse_and_flats
entrenchment .. house,access_stair
inclusiveness .. under

topic: **requirements_of_stairs**
generalisation .. design_criteria
qual .. not ladders *(taken from para 0.2 of AD)*

components of RESPONSE DEFINITION are:

purpose: **avoid_risk_of_falling**

generalisation .. afford_safe_passage
entrenchment .. safe_to_climb_or_descend

entity: **private_stairway**
generalisation .. staircase
check .. means_of_escape

CONSTRAINT: **entity shall have bounded feature: pitch**

generalisation .. steepness_of_stairs
entrenchment .. line_connecting_nosings

lower bound: **no_min**
generalisation .. only_maximum

upper bound: **degrees42**
generalisation .. steepest
inclusiveness .. under

report

"The Secretary of State is of the opinion that requirement K1 does not apply to a 'ladder' and that 'ladder' includes a flight, whether fixed or not, steeper that 55 degrees. He therefore determined that K1 does not apply to the proposed means of access to the loft room which will be at a minimum pitch of 56 degrees.

comment - *Paragraph 0.2 of the Approved Document expressly states that the requirements of the regulation do not apply to ladders. Ladders are defined as including a flight, whether fixed or not, steeper than 55 degrees.*

The Council consider that a means of escape capable of being safely and effectively used at all material times can only be provided by a stairway and that such a stairway mest be constructed in conformity with requirement K1 of Schedule 1. The point out that Appendix B of the 'Mandatory Rules' refers only to stairways, thereby implying that the use of a ladder is unacceptable.....

comment - *The Council points out that a more substantial and perhaps safer means of escape is necessary because of the stipulations of regulation B1.*

The Secretary of State noted that the means of escape would be from a single habitable room and that the local authority were satisfied with the means of escape provisions in all respects except the design of the staircase. In these circumstances he took the view that.... a means of escape in accordance with the 'Mandatory Rules' was provided."

summary

The decision of the Secretary of State is that regulation K1 does not apply and that the form of access proposed is acceptable. The qualification attached to the 'topic' component determines that the situational specification does not apply.

C8 G1 SUB-CLAUSE A (ALTERNATIVE DERIVED FROM REGULATION)

introduction

This simple regulation, although not an example of a dispute is presented as being of interest because it was dropped in the next revision of the Building Regulations. It shows how the areas of concern have been overtaken by recent developments in food storage.

the regulation

" G1. There shall be adequate accommodation for the storage of food or adequate space for the provision of such accommodation by the occupier."

program output

SECTION, REGULATION NUMBER and SUB-CLAUSE: G1a

CONTEXT of < G1a > is:

references:	**no_other_regs_implied**	
	generalisation ..	none
concerns :	**food_poisoning**	
	generalisation ..	risks_to_health_of_persons_in_buildings

comment - *Context derived from the general definition of the regulation.*

SITUATIONAL SPECIFICATION for < new_dwellings_food > is:

domain :	**buildings**	
	generalisation ..	permanent,temporary,part
	entrenchment ..	with_roof_and_walls
	inclusiveness ..	under
subdomain:	**dwellings**	
	generalisation ..	more_than_one_bed
topic :	**food_storage**	
	generalisation ..	none

comment - *'domain' and 'topic' derived from the general definition of the regulation. The sub-domain is derived from the 'Limits of application attached to the regulation which states that the requirement applies only to dwellings.*

components of RESPONSE DEFINITION are:

purpose :	**ensure_food_storage_provision**	
	generalisation ..	
	reduce_risks_to_health_of_persons_in_buildings	
entity :	**accommodation**	
	generalisation ..	separate_room
	entrenchment ..	larder

inclusiveness .. under

comment - *Derived from analysis of the regulation.*

CONSTRAINT: entity shall have bounded feature: capacity
generalisation .. volume
inclusiveness .. under
lower bound: **sufficient**
generalisation .. m3_1point75
inclusiveness .. over
upper bound: **no_max**
generalisation .. no_upper_limit

comment - *Standard constraint limits derived from analysis of the general regulation B1. Other constraints are included dealing with ventilation or refrigeration, and accessibility. The process of modelling the constraint is made clearer by restricting the output to a single subject.*

summary

The issue of interest here is that the regulation was abandoned in the next version of the regulations because it was deem that modern methods of food storage offset the risks of food poisoning that could arise from lack of designated storage facilities. In other words the original justification for the regulation no longer applied.

APPENDIX B

Tables of Appeals and Determinations

Appeals and Determinations 1989 — Appendix B

Summary of Results of Dispute Analysis

In the pages which follow the reference number given relates to the serial number of the reported dispute in the document published by the DOE.

The first part lists submissions that found in favour of the applicant and the basis for the dispute is indicated by an X in the relevant column

The second part lists submissions confirming the original findings of the Local Authority. The basis for the dispute is shown as a tick.

OVERALL RESULTS FOR ALL REPORTED DISPUTES IN THE PERIOD:

successful	84	57.14 %	*nearly 60% succesful*
unsuccessful	63	42.86 %	
	147		

(Total exceeds number of cases by 3 because 74 occurs twice and 76 three times - in separate issues)

SITUATIONAL SPECIFICATION AND RESPONSE DEFINITION AS LOCATION OF DISPUTE

SS	36	24.49 %
RD	111	75.51 %
	147	

The division into the two main segments show 75% caused by the response definition as would be expected from everyday experience.
We can see that most disputes are about how to respond to regulations that are known to apply.

success or failure of the applicants appeal or request for determination

	successful		**unsuccessful**	
SS	32	38.10 %	4	6.35 %
RD	52	61.90 %	59	93.65 %
	84		63	
	many more due to SS when successful		*most due to RD found in favour of LA*	

However, in terms of successful appeals and determinations a higher proportion were about whether the regulation should apply to the situation under consideration. It seems that in these cases Local Authorities were insisting on compliance to regulations where not warranted by the circumstances of the proposal.

AREA GIVING RISE TO DISPUTE

meaning	18	8.91 %
legislation	48	23.76 %
gaps found	133	65.84 %
new reg. envir	3	1.49 %
	202	

We can see that the bulk of the disputes arose out of uncertain descriptions in the specification of either the Situational Specification or the Response Definition.
A significant percentage involved related legislation. Interpretation of meaning was also a factor in nearly 10% of the cases.
(totals again exceed the number of cases because in many cases there are more than one factor involved)

AREA GIVING RISE TO DISPUTE RELATED TO SUCCESS OF APPEAL OR APPLICATION FOR DETERMINATION

	successful		unsuccessful	
meaning	17	13.60 %	1	1.30 %
legislation	35	28.00 %	13	16.88 %
gaps found	70	56.00 %	63 no gaps	81.82 %
new reg. envir	3	2.40 %	0	0.00 %
	125		77	

Where views of the Local Authority were upheld, working of the regulation was found adequate for the Secretary of State to find in their favour. This implies sufficiently clarity of expression.
A significant number of successfull challenges were made to the meaning of words or phrases.

REGULATION IN DISPUTE

	successful	%	unsuccessful	%	totals	%
A1	1	1.19	5	7.94	6	4.08
A2	1	1.19			1	0.68
B1	34	40.48	28	44.44	62	42.18
B2/3	3	3.57			3	2.04
B3	12	14.29	10	15.87	22	14.97
B3/4	3	3.57			3	2.04
B4	8	9.52	1	1.59	9	6.12
E1	1	1.19			1	0.68
E2			1	1.59	1	0.68
F2	1	1.19			1	0.68
G3			1	1.59	1	0.68
G4	1	1.19			1	0.68
H3			1	1.59	1	0.68
H4	1	1.19	1	1.59	2	1.36
K1	7	8.33	6	9.52	13	8.84
K1/2	1	1.19			1	0.68
K2	1	1.19	2	3.17	3	2.04
L2	2	2.38		0.00	2	1.36
M	1	1.19		0.00	1	0.68
M2	1	1.19	1	1.59	2	1.36
Reg 4	1	1.19			1	0.68
Reg 5	1	1.19			1	0.68
Reg 7	1	1.19	1	1.59	2	1.36
Schedule 2	2	2.38	5	7.94	7	4.76
	84		63		147	

Appendix B

Appeals and Determinations 1989

	Situational Specification	Response Definition	DESCRIPTION OF DISPUTE	EXPLANATION	BASIS OF DISPUTE: word or phrase meaning	related documents	incomplete definitions	new reg environment
			SUCCESSFUL APPEALS - APRIL 1989					
			Regulation B1					
7			Escape route from second floor via roofs considered unacceptable by LA as no extra fire protection provided. Solution considered analagous to normal first floor conditions and escape to place of safety accepted.	Properties defining a "place of safety"			X	
8			LA disagreed with fitting glass doors at ground level to enclose escape route. Accepted by SofS as no worse than without doors.	No stipulation regarding enclosing ground floor escape route			X	
11			travel distance exceeded requirements of BS 5588: Part 2	Amended British Standard expected - new conditions applied				X
18			Difficult to achieve double door protection - considered unnecessary by SoS due to provision of other measures - modified RD accepted	LA tried to extend properties of 'means of escape' to include double door protection to comply with CP3		X	X	
19			LA referred to floor height above 11.5m based on new build requirements - but works to existing so their view rejected	application of CP3		X	X	
20			alternative escape arrangements proposed and accepted as capable of being safely used - modified RD accepted	ditto		X	X	
21			alternative escape arrangements accepted - modified RD accepted	ditto		X	X	
22			dispute about scope - CP3 not invoked by sub-domain	not enough options to imply appropriate RD		X	X	
23			dispute over definition of maisonette access caused by gaps in SS	definition of maisonette	X	X	X	
25			dispute over adequacy of escape route	LA implying constraint equivalent to standards for new		X	X	
26			LA required extra means of escape -SoS considered	LA implying constraint equivalent to standards for new			X	
28			Constraint too onerous and not practical - alternative response accepted	conditions not envisagd in SS for extg buildings			X	
30			meaning of word "maisonette" in sub-domain	definition of maisonette	X			
32			alternative means of escape accepted as better than existing	conditions not envisagd in RD given in reg			X	
33			not materially worsened because of general upgrade	refers to BS5588:Pt3 for description of "safely used" - conditions not envisagd in RD given in reg		X	X	
34			geometry of stairs not fully described - cross ref to new BS part not in place	BS5588:Pt8 not picked up as amending Pt3 due to gap in definition of stairs geometry		X	X	
35			constraint relaxed - open stair allowed as alternative exit	conditions too onerous for small building not envisagd		X	X	
			Regulation L2					
39			amount of allowable heat loss from unconventional glazing	conditions not envisagd in SS for extg buildings			X	
40			definition of a conservatory	SS not clear about meaning of conservatory	X		X	
			DETERMINATIONS AGAINST LOCAL AUTHORITY - APRIL 1989					
			Regulation A1					
45			Swimming pool cover not requiring such stringent structural limits	SS too narrow to deal with new form of construction			X	X

	Situational Specification	Response Definition			meaning of words or phrase	related documents	incomplete definitions	changing environment of reg
			Regulation A2					
50	▒		Part of determination - addition of 5th storey not adversely affect existing	no specific provision for situation in extg buildings			X	
			Regulation B1					
53	▒		Although within SS the arrangements were equivalent to a building of less height	No specific provision for situation in existing buildings			X	
			Regulation B1					
54		▒	Widened interpretation of key diagram	LA tried to restrict RD to only example given			X	
55	▒		Interpretation of word "basement"		X			
56		▒	LA attempted to "imply" constraint for protected structure to stairs	implied meaning of sentence	X			
58		▒	LA tried to extend requirements for a stairway	SoS widened scope of "stair"	X			
59		▒	LA forced to accept space saver stair and excess distance eaves / rooflight	wider definition of RD accepted			X	
60		▒	LA forced to accept space saver stair	wider definition of RD accepted			X	
62		▒	Means of escape considered acceptable	wider definition of RD accepted			X	
66	▒		B1 considered not applicable	meaning of "is erected" disputed in SS - reference to CP3	X	X		
69	▒		Smoke lobbies not required	SS not precise about sub-domain - reefence to CP3		X	X	
70		▒	Ways of adding up totals of escape route distances	CP3 and BS 5588 - constraint definition allowed more than one RD		X	X	
72		▒	Suggested higher standard of constraint required	requirements for RD relaxed - reference to CP3		X	X	
73		▒	To be considered "safely used" higher standard of smoke extraction proposed by LA	alternative RD for constraint allowed - reference to BS 5588		X	X	
74-1		▒	Higher standards proposed by LA for protection of escape route	BS 5588 alternative RD for constraint allowed			X	
75	▒		Existing flats not required to conform to higher standards	doubt re SS			X	
76-1		▒	Adequacy of means of escape	alternative RD for constraint allowed - reference to BS 5588		X	X	
78		▒	Management arrangements and lifts for disabled persons	BS 5588 - time variation between application of parts of document - alternative RD allowed		X	X	
			Regulation B2/3					
79	▒		Internal structure adequately smoke protected - deemed not caught	dispute about description of platform doubt re SS	X		X	
80	▒		Definition of elderly - "old age not in itself a disability"	definition of elderly caused doubt about SS	X			
81		▒	Conversion of offices into flats - sub-standard structure accepted - ALSO E1	alternative RD for constraint allowed			X	
			Regulation B3					
82		▒	Different standards of fire protection accepted	alternative RD for constraint allowed			X	
84	▒		Although SS applied reduced standards accepted	definition of "single storey"- requirements for RD relaxed	X		X	
85		▒	Alternative standards accepted	requirements for RD relaxed			X	
86	▒		Accepted as mainly single storey because adequate fire separation provided	definition of "single storey" requirements for RD relaxed	X			

	Situational Specification	Response Definition			meaning of words or phrase	related documents	incomplete definitions	changing environment of reg
89	▒		Accepted as mainly single storey because adequate fire separation provided	modified interpretation of SS			X	
92		▒	Alternative fire stop accepted	alternative RD allowed			X	
93		▒	Alternative means of escape led to less stringent constraint	interpretation of "good/adequate" - alternative RD for constraint allowed	X		X	
94		▒	Alternative provisions lowered constraint	alternative RD for constraint allowed			X	
96		▒	Material proposed disputed but accepted	alternative RD allowed			X	
			Regulation B3(1)and (2)					
99		▒	Whether a particular floor construction provided sufficient fire resistance	Secretary of State considered that the proposed construction was equivalent to a standard of half an hour fire resistance and therefore complied			X	
			Regulation B3(2)					
100		▒	Small area of second storey did not pose extra risk	requirements for RD relaxed			X	
			Regulation B3(3)					
102	▒		Definition of concealed space and very high space above	SS not envisaged by regulations				X
			Regulation B3/4					
98	▒		Criteria for measuring boundary difference reinterpreted to exclude proposal	MHLG circular 17/68 - doubt regarding SS		X	X	
74-2	▒		Higher standards proposed by LA for protection of escape route	requirements for RD relaxed			X	
101	▒		SS did apply but constraint relaxed	requirements for RD relaxed			X	
			Regulation B4					
76-2		▒	Limits modified by SoS	alternative RD accepted			X	
103		▒	Thatch allowed despite regulated against	alternative RD for constraint accepted			X	
104	▒		Fire risk accepted	alternative SS accepted			X	
106		▒	Decided to exclude proposal from Regulation applying - only small extension	require ments for RD relaxed			X	
107		▒	Additional internal fire protection justified reduced standards against fire spread	alternative RD for constraints accepted			X	
108	▒		Amended SS because of sprinklers	modified SS			X	
109	▒		"notional boundary" not considered to exist within single site with industrial buildings	scope of SS defined by SoS	X			
110		▒	Proximity of thatch to boundary - purpose of regulation called into consideration	constraint relaxed			X	
			Regulation E1					
81	▒		Not applicable to existing walls	SS sub-domain confirmed			X	
			Regulation F2					
112	▒		Whether a ceiling construction would resist condensation	No void involved so regulation did not apply			X	
			Regulation G4					
115		▒	Installation of toilets in bedrooms for elderly	alternative RD accepted - reference to BS 6464:Pt1		X	X	
			Regulation H4					
117		▒	Alternative arrangements to refuse chute accepted	constraint relaxed due to Listed Building status			X	
			Regulation K1					
118		▒	LA tried to extend requirement for weather protection of fire escape	no variation to RD required because existing building			X	

	Situational Specification	Response Definition			meaning of words or phrase		related documents		incomplete definitions		changing environment of reg
121			Relocation of existing low standard fire escape agreed	constraint relaxed because solution no worse than existing					X		
125			Width of 800mm reqd - 600 accepted - limited use	modified SS to require less stringent RD - reference to BS 5395			X		X		
127			Incursion of staircase string into headroom zone not considered relevant	interpretation of headroom	X						
128			[Varying pitches on consecutive stair flights allowed	RD did not cover the proposed solution reference to BS 5395			X		X		
129			Loft ladder not covered by K1 - accepted because access to single habitable room	interpretation of "staircase"	X						
130			Different solution to Approved Document accepted	alternative RD for constraint accepted					X		
			Regulation K1/2								
131			Extending the SS to include shops by LA not agreed	LA tried to add a further feature to the RD					X		
			Regulation K2								
133			Alternative arrangement for means of eescape accepted because of use of laminated glass	alternative RD for constraint accepted					X		
			Regulation M2								
137			Lift provision covered by Regulationulation - no change	LA tried to add a further feature to the RD					X		
			Regulation M								
138			Provision for disabled access accepted	constraint definition did not preclude solution					X		
			Regulation 4(2)								
140			Conversion of garage to living room - SoS took view not "adversly affected"	adversly affected	X						
			Regulation 5								
141			Increased number of flats not a material change of use	'material' change of use	X						
			Regulation 7								
96			Material proposed disputed but accepted	alternative RD allowed					X		
			Schedule 2								
76-3			SoS decided that solution complied	RD accepted - reference to BS 5810			X		X		
136			Reduced width of ramp accepted by SoS in view of the particular circumstances	alternative RD accepted					X		
			UNSUCCESSFUL APPEALS - APRIL 1989								
			Regulation B1								
1			Loft conversion - means of escape	Cill height to eaves distance too great					✓		
2			Loft conversion - means of escape	Cill height too far from eaves					✓		
3			Loft conversion - means of escape	Cill too high for escape - could be lowered					✓		
4			Loft conversion - means of escape	Lack of fire protection to escape route					✓		
5			Loft conversion - means of escape	Cill height to eaves distance too great					✓		
6			Loft conversion - means of escape - escape hatch	Hatch proposed too near floor level risk of falling					✓		

	Situational Specification	Response Definition			meaning of words or phrase	related documents	incomplete definitions	changing environment of reg
9			Loft conversion - means of escape	Unprotected escape route at first floor level - reference to CP 3		✓	✓	
10			Loft conversion - means of escape	Retractable ladder - considered not available at all times			✓	
12			Loft conversion - means of escape	Retractable ladder - considered not available at all times			✓	
13			Loft conversion - means of escape	Inadequate protected route for occupancy load. Omission in Appendix B to Part B1			✓	
14			Loft conversion - means of escape	Lack of fire protection to escape route		✓	✓	
15			Roof conversion - 3 storey to 4 storey house	No alternative escape route - see BS 5588:1		✓	✓	
16			Means of escape from 3 storey house	Lack of fire door protection to escape route - see BS 5588:1		✓	✓	
17			Means of escape using spiral 'Spacesaver' stair	Decided that type of stairs was not a ladder which could be safely and effectively used at all material times			✓	
24			Means of escape from room in roof - fourth storey	Inadequately fire protected stairway - CP 3 Ch IV Part 1			✓	
27			Means of escape from flats and maisonettes	Dispute regarding whether a gallery at high level is potentially a habitable room	✓		some	
29			Means of escape from additional storey on 5 storey block of flats	Inadequately fire protected stairway - CP 3 Ch IV Part 1			✓	
31			Means of escape from Cold Store	Excessive travel distance - no justification to extend - see BS 5588:1		✓	✓	
36			Means of escape from Warehouse where members of the public may attend	Excessive travel distance - no justification to extend - see BS 5588:2		✓	✓	
			Regulation B3					
37			Fire spread and the provision of cavity barriers where much of the ceiling was the open grid type	Decided that some loss of observation would be inevitable, especially where the solid areas bounded the open sections			✓	
			Regulation H3					
38			Open risers to a spiral staircase exceeding the 100mm limit	Decided that there was no justification to modify regulation			✓	
			Schedule 2/Part M					
41			Access for disabled staff to first floor offices of a Supermarket	No acceptable justification submitted for ignoring requirement for a lift			✓	
42			Sanitary accommodation for disabled persons working in a petrol filling station	No acceptable justification submitted for ignoring requirement for sanitary accommodation for disabled persons			✓	
43			Sanitary accommodation for disabled persons working in factory units	No acceptable justification submitted for ignoring requirement for sanitary accommodation for disabled persons			✓	
44			Sanitary accommodation for disabled persons working in office building.	Secretary of State stated that a minimum requirement would be 50% more sanitary accommodation than proposed for disabled persons			✓	
			Regulation A1					
46			Whether a flint external skin of walling was equivalent to a brick skin	Wall must comply with BS 5628:Part 1clause 29.5(b) and not clause 23.1.9		✓	✓	
47			Whether a conversion of a garage was capable to sustain extra loading of blockwork	Lack of adequate information provided to demonstrate adequate strength			✓	

	Situational Specification	Response Definition			meaning of words or phrase	related documents	incomplete definitions	changing environment of reg
48			Whether a soil investigation was required	Lack of adequate information provided to confirm ground bearing capability			✓	
49			Whether proposed method of underpinning would be adequate	Lack of adequate information provided to confirm adequacy of proposal			✓	
51			Whether the proposed structure for a new garage would be adequate	Lack of adequate information provided to confirm load bearing capacity of proposal			✓	
			Regulation B1					
52			Whether second storey storage areas in a house complied with BS 5588 Section 1.1	Not proposed for use as a habitable room bu could be so used in future		✓	✓	
57			Whether safe means of escape had been provided in view of pitch and construction	Pitch of staircase more than 55 degrees and not useable as a ladder therefore not a safe means of escape			✓	
61			Whether a loft conversion had adequate means of escape	Headroom only 1.55mm (not 2metres as stipulated) and therefore inadequate			✓	
63			Whether the use of two ladders as means of escape from room in the roof was acceptable	Roof of extension not proved to be capable of supporting the upper ladder and inadequately fire protected route			✓	
64			Whether glazing in a stair wa satisfactory and whether reduced headroom on a stairway and landings was acceptable	Not a safe passage for users due to inadequate fire protection and lack of headroom			✓	
65			Whether a space-saver stair provided adequate means of escape and whether a window should be guarded to prevent falling	Not a safe means of escape due to type of staircase and lack of guarding			✓	
67			Whether means of escape from flats was satisfactory in view of lack of conformity with CP 3:ChIV:Part1	Double door protection did not accord precisely with the Code of Practice		✓	✓	
68			Whether means of escape from flats was adequate	No proper alternative means of escape as required by CP 3:ChIV:Part1		✓	✓	
77			Whether regulation applies to office layouts that are partly open plan	Open plan arrangement threatened access to alternative escape stairs and did not comply with BS5588:Part3		✓	✓	
			Regulation B3					
71			Whether compartmentation should be taken into account when considering means of escape	Means of escape not 'good and adequately protected			✓	
							✓	
83			Whether fire resistance of a floor in an elderly persons home was adequate	Proposal did not provide required 1 hour fire resistance			✓	
87			Whether a staircase in a hotel should have complete vertical separation	Insufficient information provided to demonstrate compliance			✓	
88			Whether a compartment wall was required between a service area and a sales area	Compartmentation needed because of different fire and life risks caused by different functions			✓	
90			Whether installing mezzanine floors was safe in Office buildings	Insufficient information provided to demonstrate compliance			✓	
91			Whether arches supporting a building have adequate fire resistance	Lack of adequate fire protection			✓	
95			Whether provision of a roller shutter was adequate fire compartmentation between shop a mall	Lack of complete fire compartmentation			✓	
97			Whether fire resistance to the second floor in an elderly persons home was adequate	Proposal did not provide required 1 hour fire resistance			✓	
144			Whether internal windows between kitchen and corridor provided sufficient compartmentation	Risk of fire spreading from kitchen to kitchen where they are opposite due to lack of insulation properties of the glass - (BS 476:Part 8)		✓	✓	

	Situational Specification	Response Definition			meaning of words or phrase	related documents	incomplete definitions	changing environment of reg
			Regulation B4					
105			Whether thatching existing house extension roof provided adequate resistance to the spread of fire	Roof less than minimum of 12 metres from the boundary for fire resistance proposed			✓	
			Regulation E2					
111			Whether a floating floor should be provided for resistance to airborne sound	Secretary of State considered a floating layer is an essential component to stop airborne sound			✓	
			Regulation G3					
114			Whether an unvented hot water system is safe	Un-recognised method of providing an unvented system did not follow principles laid down in BS 6700		✓	✓	
			Regulation H4					
116			Access to facilities for refuse disposal in a six storey block of flats	Waste containers not easily accessible and therefore did not comply			✓	
			Regulation K1					
119			Whether alterations to a stairway complied	Did not afford safe passage			✓	
120			Whether unequal winders constituted a hazard	Did not afford safe passage			✓	
122			Whether lack of a proper landing constituted a hazard	Did not afford safe passage			✓	
123			Whether spiral staircase complied	Lack of information provided to demonstrate compliance			✓	
124			Whether adequate headroom had been provided	1.83 metres too much less that 2 metres required			✓	
126			Whether landings and headroom in connection with space-saver stairs afford safe passage	Reduced headroom not acceptable			✓	
			Regulation K2					
126			Whether a rooflight was adequately guarded	Lack of safety glass prevented compliance			✓	
134			Whether a rooflight was adequately guarded	Lack of safety glass prevented compliance			✓	
			Schedule 2 / Part M					
135			Whether an alternative access for the disabled was suitable	Alternative route proposed had inappropriate surface and was too long and too narrow			✓	
			M2					
139			Whether access for disabled persons should be provided in a new building in a private school	No justification for relaxing the regulation			✓	
			Regulation 7					
139			Whether sealant and tape was suitable to fix double glazing in a 17 storey building	Not acceptable in view of the likely rate of deterioration in relation to the life of the building			✓	

APPENDIX C

Examples of Program Output

```
bregs.

yes
?- load.
brframes.ari data loaded
yes
?- add.

    REGULATION FRAME - DATA ENTRY

   ££££££££££££££££££££££££££££££££££££££

 1: enter SECTION_CLAUSE NUMBER

example.
 2: check CONTEXT

Context named < fire_resistance_of_structure >

references .. [v(bs476_Fire Tests)]
concerns .. [v([risk_of-fire_spread,collapse])]

  is this the CONTEXT of the regulation ? y/n =>
n.
    references is..  bs476_Fire_Tests
          generalisation .. [v(part8_fire_resistance_of_elements)]
    concerns is.. [risk_of_fire-spread,collapse]
          generalisation .. [v(entrapment)]

would it match if one component changed? y/n =>
n.

Context named < gl_food_storage >

references .. [v(no_other__regs_implied)]
concerns .. [v(food_poisoning)]

  is this the CONTEXT of the regulation ? y/n =>
    references is.. no_other_regs_implied
          generalisation .. [v(none)]
    concerns is.. food_poisoning
       generalisation .. [v(risks_to_health_of_persons_in_buildings)]

would it match if one component changed? y/n =>
n.

Context named < means_of_escape_fire >

references .. [v(bRegs85_mandatory_rules)]
concerns .. [v(death_or_injury_from_fire)]

 is this the CONTEXT of the regulation ? y/n =>
n.
    references is.. bRegs85_mandatory_rules
          generalisation .. [v(mandatory_rules)]
          entrenchment .. [v(fire_escape_regulations)]
          inclusiveness .. [v(under)]
    concerns is.. death_or_injury_from_fire
          generalisation .. [v([suffocation,burning,collapse])]
would it match if one component changed? y/n =>
n.

Context named < means_of_escape_fire_dh >
ako .. [v(means_of_escape_fire)]
references .. [v(bRegs85_mandatory_rules,bs5588_s1])]

 is this the CONTEXT of the regulation ? y/n =>
y.
```

```
3: check SITUATIONAL SPECIFICATION
 SS named <b_wks_sanitation > is:

domain .. [v(buildings)]
subdomain .. [v(varies)]
topic .. [v(sanitary_conveniences)]
specifics .. [v([workplaces,o_s_rway_prems_Act,food_businesses])]

is this the triggering SITUATIONAL SPECIFICATION ? y/n =>
n.
    domain is.. buildings
          generalisation .. [v([permanent, temporary,part])]
          entrenchment .. [v(with_roof_and_walls)]
          inclusiveness .. [v(under)]
          qual .. [v(is_erected)]
    subdomain is.. varies
          generalisation .. [v(defined_by_building_type)]
    topic is.. sanitary conveniences
          generalisation .. [v(closets_urinals)]

would it match if one component changed? y/n =>
n.
 SS named <fire_precautions > is:

domain .. [v(buildings)]
subdomain .. [v(restricted_by_clause)]
topic .. [v(in_case_of_fire)]

 is this the triggering SITUATIONAL SPECIFICATION ? y/n =>
n.
    domain is.. buildings
          generalisation .. [v(permanent,temporary,part])]
          entrenchment .. [v(with_roof_and_walls)]
          inclusiveness .. [v(under)]
          qual .. [v(is erected)]
    subdomain is.. restricted_by_clause
          generalisation .. [v(none)]
    topic is.. in_case_of_fire
          generalisation .. [v(combustion)]
          entrenchment .. [v(permanent_fire_risk)]

would it match if one component changed? y/n =>
y.
which component is different?
subdomain.

enter component value for: subdomain
cottages.

enter generalisation or [list]
small_house.

is there an entrenchment? y.

enter entrenchment
less_than_50sqmetres.

is there over/under inc? y.

enter <over> or <under>
under.
any more slots ? y/n
y.
enter slot name
qual.
enter slot value
not_thatched.
any more slots ? y/n
```

```
n.
OK
give replacement name for > fire_precautions
fire_precautions_cottages.
 4: check RESPONSE DEFINITION:

Response Definition named < rd(rB1) > is :
purpose .. [v(safe_escape)]
entity .. [v(means_of_escape)]
crt .. [v(shall_have_bounded_feature(capable_of_being_used,bnds(at_all_
material_times,no max)))]
 is this the right RESPONSE DEFINITION for this clause ? y/n =>
y.

regulation example entered regulation example successfully entered
y.
? - show(example).
The SECTION, REGULATION NUMBER and SUB-REFERENCES are: example

The CONTEXT of < means_of_escape_fire_dh > is:
      references    [bRegs85_mandatory_rules,bS5588_s1]
      concerns    death_or_injury_from_fire

SITUATIONAL SPECIFICATION for < fire_precautions_cottages > is:
    domain    buildings
    subdomain    cottages
    topic    in case of fire

characteristics of RESPONSE DEFINITION < rd(rB1) > are:

    purpose    safe_escape
    entity    means_of_escape

CONSTRAINT:
      entity SHALL HAVE the bounded feature:  capable_of_being_used
    Lower bound:   at_all_material_times
    Upper bound:   no_max

Simple expansion of regulation complete
yes
?-qshow(example).
The SECTION and REGULATION NUMBER are: example

The CONTEXT of < means_of_escape_fire_dh > is:
      references is.. [bRegs85_mandatory_rules,bS5588_s1]
      generalisation .. [v([mandatory_ rules,cp_single_
      family_dwellings])]
          entrenchment .. [v(fire_escape_regulations)]
          inclusiveness .. [v(under)]
    concerns is.. death_or_injury_from_fire
          generalisation .. [v([suffocation,burning,collapse])]

The SITUATIONAL SPECIFICATION for < fire_precautiona_cottages > is:
    domain is.. buildings
          generalisation .. [v([permanent,temporary,part])]
          entrenchment .. [v(with_roof_and_walls)]
          inclusiveness .. [v(under)]
          qual .. [v(is_erected)]
    subdomain is.. cottages
          generalisation .. [v(small_house)]
          entrenchment .. [v(less_than_50sqmetres)]
          inclusiveness .. [v(under)]
          qual .. [v(not_thatched)]
    topic is.. in_case_of_fire
          generalisation .. [v(combustion)]
          entrenchment .. [v(permanent_fire_risk)]

components of RESPONSE DEFINITION rd(rB1) are:
```

```
    purpose is.. safe_escape
          generalisation ..[v(rescueable)]
          entrenchment .. [v([within_30_mins)]
          inclusiveness .. [v(under)]
    entity is.. means_of_escape
          generalisation ..[v(safe_route_structural,from_any_point_
       in_building])]
       entrenchment .. [v(protected)]
       inclusiveness .. [v(over)]
       qual ..[v(to_place_of_safety_outside)]

CONSTRAINT:  entity shall have bounded feature:  capable_of_being_used
          generalisation .. [v(without_assistance)]
          entrenchment .. [v(by_ambulant_persons)]
          qual .. [v(safely_and_effectively)]
    Lower bound: at_all_material_times
          generalisation .. [v(none)]
          entrenchment .. [v(continuously)]
          inclusiveness .. [v(over)]
    Upper bound: no_max
          Generalisation .. [v(no_upper_limit)]

Description of qualified regulation complete

Yes
?-
```

APPENDIX D

Program Code

APPENDIX D THE PROLOG PROGRAM CODE

The program is made up from four modules called from a short header program. The frames are made up from an identifier or frame name, followed by a list of the slots and their values. The values can be a single Prolog atom or a further list. In the case of the constraint the Prolog atom is in the form of a Prolog structure. An additional Prolog operator is defined to simplify interpretation' .. ' to separate slot name from slotlist

The modules carry out the following tasks:

1. breg_1.ari finding frame slots and returning values for facet and slot.
2. breg_2.ari entry of regulations
3. breg_3.ari display of regulations
4. breg_4.ari utilities

The first two modules interact with the user and influence the output from the process.

Appendix C contains example screen dumps to indicate how the question and answer routine operates.

frame access predicates - breg_1.ari

There are four versions:

1. a test to confirm if a certain value exists where the request is not for a variable
2. the most common case, in which the value is a variable and the slot is a member of the slot list
3. if the slot is not in the given list for the frame the values in the 'opff' slot are used to see if there is a superior class from which to inherit a value for theoperative facts
4. if the slot is not in the given list for the frame the values in the 'ako' slot are used to see if there is a superior class from which th inherit a value

A routine then deals with the actual process of getting the values within the facet and again deals with four cases:

1. facet and value are on the facet list covering the 'val' facet as well as specific request for other facets

2. the requested facet is 'val' on the facet list and its value is a list using 'member' to get a value

3. there is a default facet to provide a value

4. there is an embedded procedure to evaluate the value using a formal request as the argument

In addition there are predicates for adding, deleting and modifying frames as well as utilities for file handling, and internal processes necessary for the function of the program.

data entry routines - breg_2.ari

Questions raised by the program assume some pre-processing of the regulation. Input is as single words, phrases with words linked by underscores, or as a list of atoms of either form. If it is found necessary to modify an entry, a text editor is used to avoid the necessity for a series of editing predicates.

A predicate, 'get_ent' identifies the entity that is being controlled by the regulation and 'get_constraint' offers a further menu for determining the type of constraint and sets up requests for the entry of necessary details using 'get_ct'.

query mechanism - breg_3.ari

Two main options are provided. The first displays the basic regulation structure without qualifiers giving an overview of the regulation's contents. The second displays the regulation along with qualifications for each component. Extra queries that are frequently used have been provided as 'process' predicates. The Prolog language in most cases makes it sufficient to query the database interactively.

A predicate 'show' finds and displays the regulation frame using 'gs' which is the main procedure for fetching slots and their contents. The predicate 'slot_vals(THING, REQLIST, SLOTLIST).' establishes an internal query in preparation for getting the contents of a particular slot. The predicate 'prep_req' builds the formal query structure in the form "prep_req(SLOT::X, req(T, SLOT, val, X))". The predicate 'find_slot' attempts to satisfy the specific request.

breg_4.ari

Apart from the DCG parsing user interface the principal change is the addition of the further quantifiers qualifying the slot values. These are shown by symbolic Prolog operators designed to make it easier to read the code. These do not appear in the displayed statements to the screen which take the following format.

```
        (member(X, AKO);X = AKO),
        f(X, HIGHERSLOTS),
        find_slot( req(T, S, F, V), HIGHERSLOTS ), !.

find_slot(REQ,_):- nl,write('not found'),write(REQ).

facet_val(req(T, S, F, V), FACETLIST):-
        FV =.. [F, V],
        member(FV, FACETLIST).
facet_val(req(T, S, v, V), FACETLIST):-
        member(v(VALLIST), FACETLIST),
        member(V, VALLIST), !.
facet_val(req(T, S, v, V), FACETLIST):-
        member(def(V), FACETLIST), !.
facet_val(req(T, S, v, V), FACETLIST):-
        member(calc(PRED), FACETLIST),
        PRED =.. [FUNCTOR | ARGS],
        CALCPRED =.. [FUNCTOR, req(T, S, v, V)| ARGS],
        call(CALCPRED).
```

/* BREGS_2.ARI 311295 */

```
/* ENTERS REGULATION AND ASSERTS READY FOR SAVING        */

add :-
        cls,nl, write('     REGULATION FRAME - DATA ENTRY '), nl, nl,
        write('  ##########################################'), nl, nl,
        write(' 1: enter SECTION_CLAUSE NUMBER'), nl, nl, read(ID),
        cls,write(' 2: check CONTEXT'),nl, check_tx(TX),
        cls,write(' 3: check SITUATIONAL SPECIFICATION'),nl, check_ss(SS),
        cls,write(' 4: check RESPONSE DEFINITION:'),nl, check_rd(ID,TX,SS),
        write(' regulation '), write(ID), write(' successfully entered').
check_tx(TX):-                  % TRACKS EXISTING TX NAMES
        txget(LST), get_existing_tx(LST, TX).    % uses list of names of context segment
frames
get_existing_tx([], TX):- new_tx(TX).
get_existing_tx([H|T], TX):-                    % shows context components
        nl,write('Context named < '),write(H),write(' >'),nl,
        f(H,CNTXT),showlist(CNTXT), nl,nl,
        write(' is this the CONTEXT of the regulation ? y/n =>'),
        nl,read(ANS), ANS='y', H = TX; txslots(L), similar(tx,H,TX,T,L).

check_ss(SS):-                  % TRACKS EXISTING SS NAMES
        ssget(LST), get_existing_ss(LST, SS).   % uses list of names of sitspec segment
frames
get_existing_ss([], SS):- new_ss(SS).
get_existing_ss([H|T], SS):-                    % shows sitspec components
        write(' SS named < '),write(H),write(' > is: '),nl,
        f(H,SPEC),showlist(SPEC), nl,nl,
        write(' is this the triggering SITUATIONAL SPECIFICATION ? y/n =>'),
        nl,read(ANS), ANS='y', H = SS; ssslots(L), similar(ss,H,SS,T,L).

check_rd(ID,TX,SS):-            % TRACKS EXISTING RD NAMES
        rdget(LST), get_existing_rd(LST,ID,TX,SS).    % uses list of names of resdef segment
frames
```

```
/* BREGS.ARI                    301295                              */

/* Top routine that calls all others                                */

:-op(900,xfx,..).

bregs:-
        reconsult('bregs_1.ari'),       % frame engine
        reconsult('bregs_2.ari'),       % add predicates

        reconsult('bregs_3.ari'),       % show predicates
        reconsult('bregs_4.ari').       % utilities
```

```
/* BREGS_1.ARI          FRAME ACCESS            301295              */

/* A neutral process for finding slots and their values that also   */
/* allows use of lists as part of slot without separate identification */

gs(THING,REQLIST):-
        f(THING, SLOTLIST),
        slot_vals(THING, REQLIST, SLOTLIST).

slot_vals(_, [], _).
slot_vals(T, [REQ|REST], SLOTLIST):-
        prep_req(REQ, req(T, S, F, V)),
        find_slot(req(T, S, F, V), SLOTLIST),
        !,slot_vals(T, REST, SLOTLIST).
slot_vals(T, REQ, SLOTLIST):-
        prep_req(REQ, req(T, S, F, V)),
        find_slot(req(T, S, F, V), SLOTLIST).

prep_req(SLOT..X, req(T, SLOT, v, X)):-
        var(X), !.
prep_req(SLOT..X, req(T, SLOT, FACET, VAL)):-
        nonvar(X),
        X =.. [FACET, VAL],

facet_list(FL),
        member(FACET, FL),!.
prep_req(SLOT..X,req(T, SLOT, v, X)).

facet_list([v, def, calc, add, del, revise]).

find_slot(req(T, S, F, V), SLOTLIST):-
        nonvar(V),
        find_slot(req(T, S, F, VAL), SLOTLIST),!,
        (VAL==V; member(V, VAL)).
find_slot(req(T, S, F, V), SLOTLIST):-
        member(S..FACETLIST, SLOTLIST),!,
        facet_val(req(T, S, F, V), FACETLIST).
find_slot(req(T, S, F, V), SLOTLIST):-
        member(ako..FACETLIST, SLOTLIST),
        facet_val(req(T, ako, v, AKO), FACETLIST),
```

```
get_existing_rd([],ID,TX,SS):- new_rd(ID,TX,SS).
get_existing_rd([H|T], ID,TX,SS):-        % shows resdef components
        cls,nl,write('Response Definition named < '),write(H), write(' > is :'),
        f(H,RESDEF),showlist(RESDEF),
        ni,write('  is this right Response Definition for this clause ? y/n =>'),
        nl,read(ANS), ANS='y', nl,write('regulation '), write(ID),write(' entered'),
        assertz(f(ID, [tx..[v(TX)], ss..[v(SS)], rd..[v(H)] ] ));
        rds(L), similar_rd(H,ID,TX,SS,T,L).
/* CREATES TX / SS FRAME WITH AKO COMPONENT IF APPROPRIATE  */

similar(SEG,Orig_SegName,New_SegName,Rest_of_Names,ListOfSlots):-
        qslot_get(Orig_SegName, ListOfSlots),  % list qualified segment components
        nl,write('would it match if one component changed? y/n =>'), nl,
        read(ANS), sim_result(ANS,SEG,Orig_SegName, New_SegName,Rest_of_Names).

sim_result(n,tx,X,Y,Z):-get_existing_tx(Z,Y).
sim_result(n,ss,X,Y,Z):-get_existing_ss(Z,Y).
sim_result(y,SEG,X,Y,Z):-
        write('which component is different?'),nl,read(COMP),nl,
        write('enter component value for: '),write(COMP),nl,read(VAL),nl,
        check_ex(VAL),          % shows if exists or succeeds - ? enhance
        qualify_object(VAL,QOBJ), write('give replacement name for > '),
        write(X),nl,read(Y),check_ex(Y),
        new_segment(Y,X,COMP,VAL).


/*  CREATES NEW RD FRAME WITH AKO COMPONENT IF APPROPRIATE  */

similar_rd(Orig_SegName, ID,TX,SS, Rest_of_Names, ListOfSlots):-
        qslot_get(Orig_SegName, ListOfSlots),nl,
        gs(Orig_SegName,[crt..CRT]),qshow_crt(CRT),nl,        % lists qualified constraint
        nl,write('would it match if one component changed? y/n =>'), nl,
        read(ANS), sim_result_rd(ANS,Orig_SegName, ID,TX,SS, Rest_of_Names).

sim_result_rd(n, X, ID,TX,SS,Z):- get_existing_rd(Z, ID,TX,SS).
sim_result_rd(y, X, ID,TX,SS,Z):-
        write('which component is different?'),nl,read(COMP),nl,
        add_rd_seg(COMP,X,ID,TX,SS).

add_rd_seg(crt,X,ID,TX,SS):-              % builds modified resdef with new constraint
        get_crt(CRT),
        assertz(f(rd(ID),[ako..[v(X)], crt..CRT ])),   % new segment with new crt
        assertz(f(ID, [tx..[v(TX)], ss..[v(SS)], rd..[v(rd(ID))] ] )).    % new reg

add_rd_seg(COMP,X,ID,TX,SS):-         % builds modified resdef with new object
        write('enter component value for: '),write(COMP),nl,read(VAL),nl,
        check_ex(VAL),          % shows if exists or succeeds
        qualify_object(VAL,QOBJ),
        assertz(f(rd(ID),[ako..[v(X)], COMP..[v(VAL)]])), %new segment
        assertz(f(ID, [tx..[v(TX)], ss..[v(SS)], rd..[v(rd(ID))] ] )). %new reg


/*      BRAND NEW SEGMENT FRAME WITH NEW COMPONENTS */

new_tx(TX):-            % BUILDS NEW CONTEXT FRAME SEGMENT
        write('Give new segment name for new CONTEXT Frame'),nl,read(TX),
        write('Enter REFERENCES  =>  '), read(RF), nl, nl,
        qualify_object(RF,QR),
```

```
        write('Give new CONCERNS  =>  '), read(CNCN), nl, nl,
        qualify_object(CNCN,QC),
        assertz(f(TX,[ references..[v(RF)],concerns..[v(CNCN)]])).


new_ss(SS):-            % BUILDS NEW SITUATIONAL SPECIFICATION SEGMENT
        nl, write('Give name for SITUATIONAL SPECIFICATION'),nl,read(SS),
        write('Give new DOMAIN  =>  '), read(DOMAIN), nl, nl,
        qualify_object(DOMAIN,QD),
        write('Give new SUBDOMAIN =>  '), read(SDOM), nl, nl,
        qualify_object(SDOM,QS),
        write('Give new TOPIC  =>  '), read(TPC), nl, nl,
        qualify_object(TPC,QT),
        assertz(f(SS,[ domain..[v(DOMAIN)],subdomain..[v(SDOM)],topic..[v(TPC)] ])).

new_rd(ID,TX,SS):-      % BUILDS NEW RESPONSE DEFINITION SEGMENT
        write('Give new PURPOSE  =>  '), read(PURPOSE), nl, nl,
        qualify_object(PURPOSE,QP),
        write('Give new ENTITY controlled by regulation clause  =>  '), read(ENT), nl, nl,
        qualify_object(ENT,QE),
        write('5: Finally, enter the CONSTRAINT limiting '), write(ENT),nl,nl,
        get_crt(CRT),
        assertz(f(rd(ID),[purpose..[v(PURPOSE)], entity..[v(ENT)], crt..CRT ])),
        assertz(f(ID, [tx..[v(TX)], ss..[v(SS)], rd..[v(rd(ID))] ] )).


/*              BUILDS THE CONSTRAINT STRUCTURE                 */

get_crt(CRT):-
        write('SELECT CONSTRAINT FORMAT  '),nl,nl,nl,
        write('    1   entity - MUST BE PROVIDED'), nl, nl,
        write('    2   entity - MUST HAVE PRESCRIBED FEATURE'), nl, nl,
        write('    3   entity - MUST HAVE BOUNDED FEATURE'), nl, nl,
        read(REPLY),get_reply(REPLY, CRT).

get_reply(1, CRT):-
        CRT = [v(shall_be_entity)].
get_reply(2, CRT):-
        write('enter FEATURE prescribed'), nl, read(FEA),
        qualify_object(FEA,QFlist),
        CRT = [v(shall_have_feature(FEA))].

get_reply(3, CRT):-
        write('Enter FEATURE prescribed'), nl, read(FEA),
        qualify_object(FEA,QFlist),
        write('Enter lower bound or anon value'), nl, read(LOWERBOUND),
        qualify_object(LOWERBOUND,QLlist),
        write('Enter upper bound or anon value'), nl, read(UPPERBOUND),
        qualify_object(UPPERBOUND,QUlist),
        CRT = [ v(shall_have_bounded_feature(FEA,
bnds(LOWERBOUND,UPPERBOUND)))].


/*      BUILDS QUALIFIER FRAME FOR COMPONENT OBJECT      */

qualify_object(X,QUALLIST):-
        qgen(G,generalisation),append([],G,L1),
        qent(E,entrenchment),append(L1,E,L2),
```

```
        qinc(I,inclusiveness),append(L2,I,L3),
        extra(SLOT),append(L3,SLOT,QUALLIST),
        assertz( f(X, QUALLIST) ).

qgen(X,Y):-     % THERE MUST BE A GENERALISATION IN SOME FORM
        write('enter generalisation or [list]'),nl,
        read(Reply),X=[Y..[v(Reply)]].

qent(X,Y):-
        nl,write('is there an entrenchment? '),read(A),nl,
        A=y,write('enter entrenchment'),nl,
        read(Ent),X=[entrenchment..[v(Ent)]]; X=[].

qinc(X,Y):-
        nl,write('is there over/under inc? '),read(A),nl,
        A=y,write('enter <over> or <under>'),nl,
        read(Inc),X=[inclusiveness..[v(Inc)]]; X=[].

extra(X):- extra([],L1),reverse(L1,X).
extra(L1,L2):-
        write('any more slots ? y/n'),nl,read(Ans),
        Ans=n, write('OK'),nl, L1=L2,!.
extra(L1,L2):-
        write('enter slot name'),nl,read(N),
        write('enter slot value'),nl,read(V),
        reverse([N..[v(V)]],R2),
        append(R2,L1,L3),extra(L3,L2).

new_segment(New_Seg, Orig_Seg, COMP,VAL):-
        assertz(f(New_Seg,[ako..[v(Orig_Seg)], COMP..[v(VAL)]])).
```

```
/* BREGS_3.ARI                                    301295        */

/* predicates display regulations or part depending query entered        */

/*      DISPLAYS THE WHOLE FRAME USING 'ID' TO FIND IT        */
show(REG):-
        show_frame(f(REG,SSLIST)).

show_frame(f(REG, LISTofSLOTS)):-
        write('The SECTION, REGULATION NUMBER and SUB-REFERENCES are: '),
        write(REG), nl,nl,
        write('The CONTEXT of  < '),
        gs(REG,[tx..TX]),write(TX),write('  > is:'),nl,
        txslots(TXSLOTS),slot_get(TX,TXSLOTS),nl,
        write('SITUATIONAL SPECIFICATION for  < '),
        gs(REG,[ss..SS]),write(SS),write('  > is:'),nl,
        ssslots(SSSLOTS),slot_get(SS,SSSLOTS),nl,
        write('characteristics of RESPONSE DEFINITION  < '),
        gs(REG,[rd..RD]),write(RD),write('  > are:'),nl,nl,
        rds(RDSLOTS),slot_get(RD,RDSLOTS),nl,
        write('CONSTRAINT: '),nl,gs(RD,[crt..C]),
        show_crt(C),nl, write('Simple expansion of regulation complete').
```

```
slot_get(FRAME,[]).
slot_get(FRAME,[SLOT|T]):-
        gs(FRAME,[SLOT..VALUE]), write('   '),write(SLOT), write('   '), write(VALUE), nl,
        slot_get(FRAME,T).

show_crt(shall_be_entity):-
        write('   entity SHALL BE provided'), nl.
show_crt(shall_have_feature(FEA)):-
        write('   entity SHALL BE provided and have the:'), nl,
        write(' prescribed FEATURE'), nl, write(FEA).
show_crt(shall_have_bounded_feature(FEA,bnds(X,Y))):-
        write('   entity SHALL HAVE the bounded feature:  '),write(FEA), nl,
        write('   Lower bound:  '),  write(X),nl,
        write('   Upper bound:  '),  write(Y),nl.

qshow(REG):-            % DISPLAYS QUALIFIED FRAME USING JUST THE 'ID' TO FIND IT
        show_qframe(f(REG,SSLIST)).

show_qframe(f(REG, LISTofSLOTS)):-  % DISPLAYS QUALIFIED FRAME USING JUST 'ID'
        write('The SECTION and REGULATION NUMBER are: '), write(REG), nl,nl,
        write('The CONTEXT of  <  '),
        gs(REG,[tx..TX]),write(TX),write('  > is:'),nl,
        txslots(TXSLOTS),qslot_get(TX,TXSLOTS),nl,
        write('The SITUATIONAL SPECIFICATION for  < '),
        gs(REG,[ss..SS]),write(SS),write('  > is:'),nl,
        ssslots(SSSLOTS),qslot_get(SS,SSSLOTS),nl,
        write('components of RESPONSE DEFINITION '),
        gs(REG,[rd..RD]),write(RD),write(' are:'),nl,nl,
        rds(RDSLOTS),qslot_get(RD,RDSLOTS),nl,
        gs(RD,[crt..CRT]),qshow_crt(CRT),nl,
        write('Description of qualified regulation complete'),nl.

qslot_get(QFRAME,[]).
qslot_get(QFRAME,[SLOT|T]):-
        gs(QFRAME,[SLOT..VALUE]), write('   '),write(SLOT), write(' is..  '),write(VALUE), nl,
        f(VALUE,QSLOTS),qualslot_show(QSLOTS),
        qslot_get(QFRAME,T).

qshow_crt(shall_be_entity):-
        write('Constraint: the entity SHALL BE provided'), nl.
qshow_crt(shall_have_feature(FEA)):-
        write('Constraint: the entity SHALL BE provided and have the:'), nl,
        write(' prescribed FEATURE'), nl, write(FEA),
        f(FEA,QSLOTS),qualslot_show(QSLOTS).
qshow_crt(shall_have_bounded_feature(FEA,bnds(X,Y))):-
        write('CONSTRAINT:   entity shall have bounded feature:  '),write(FEA), nl,
        f(FEA,QSLOTS1),qualslot_show(QSLOTS1),
        write('   Lower bound:  '),  write(X),nl,
        f(X,QSLOTS2),qualslot_show(QSLOTS2),
        write('   Upper bound:  '),  write(Y),nl,
        f(Y,QSLOTS3),qualslot_show(QSLOTS3).


qualslot_show([]),                  % call all the q slots in turn
qualslot_show([A|B]):-
        write('          '),write(A), nl, qualslot_show(B).

qual(QUALFRAMENAME):-
```

```
        gs(QUALFRAMENAME,[generalisation..G]),write('    generalisation = '),write(G),nl,
        gs(QUALFRAMENAME,[entrenchment.. E]),write('    entrenchment   = '),write(E),nl,
        gs(QUALFRAMENAME,[inclusiveness.. I]),write('    inclusiveness  = '),write(I),nl.


/*      SHORT QUERIES FOR FINDING COMPONENTS                    */

split(F,SS,RD):-f(F,[ss..SS,rd..RD]).

slots(Frame,Slots):-f(Frame,Slots).

parts(F):-f(F,[ss..[v(SS)],rd..[v(RD)]]),write('frame:'),write(F),nl,
        f(SS,SPEC),write(SPEC),nl,nl,f(RD,DEF),write(DEF),nl.
if_ex(X):-gs(Y,domain..X),f(X,L),write(L).

test(REG,[]).
test(REG,[H|T]):-
        gs(REG,[H..X]), write('   '),write(H), write(' is  - '),write(X),nl,
        test(REG,T).
test(REG,_).
```

```
/*  BREGS_4.ARI          UTILITIES                  301295      */

/*              FRAME HANDLING                                  */

showlist([]).                                   % writes each item of list to screen
showlist([H|T]):- nl,write(H),showlist(T).

txget(TXnames):- setof(X,txf(X),TXnames).       % gets context frame Ids

txf(TX):-f(F,[tx..[v(TX)],SS, RD]).

ssget(SSnames):- setof(X,ssf(X),SSnames).               % gets sitspec frame IDs

ssf(SS):-f(F,[TX,ss..[v(SS)], RD]).

rdget(RDnames):- setof(X,rdf(X),RDnames).       % gets respdef frame IDs

rdf(RD):-f(F,[ TX,SS, rd..[v(RD)]]).

txslots([references,concerns]).       % names of the slots in the contextural outline
ssslots([domain,subdomain,topic]).% names of the slots in the sitspec
rdslots([purpose,entity,crt]).          % names of the slots in the response definition
rds([purpose,entity]).                  % names of the slots without crt

check_element_quals(E,T,SS).
check_element_quals(domain,T,SS):-    % for all elements to be re-used
        gs(SS,domain..D),f(D,QUALS), nl,write('are these qualifications correct'),
        read(ANS), ANS='y'.

test_ssf(Frames):- gs(Frames,domain..D).
test_ssf(N):- f(N,[ domain .. [v(D)], subdomain .. [v(S)],topic .. [v(T)] ]).
```

```
check_ex(X):- f(X,S),write(S),nl.
check_ex(X).

ppget(Pnames):- bagof(P,pp(P),Pnames).          % gets purpose names
pp(P):- f(rd(R),[ purpose .. [v(P)], B,C]).     % fixed number of slots

eeget(Enames):- bagof(E,ee(E),Enames).          % gets entity names
ee(E):- f(rd(R),[ P,entity..[v(E)],C]).         % fixed number of slots

/*              FILE HANDLING                                   */

load:- reconsult('brframes.ari'), write('brframes.ari data loaded').

keep:- tell('brframes.ari'), send, nl, write('data saved to brframes.ari').

send:- f(A,B), write(f(A,B)), write('.'), nl, fail.
send:- told.

freg(X):- tell('reg.ari'), send(X), nl, write('output sent  to reg.ari').

send(X):- qshow(X), write(qshow(X)),told.

/*              STANDARD DEFINITIONS                            */

member(X, [X | _ ]).
member(X, [_ | Xs]) :- member(X, Xs).

append([], Ys, Ys).
append([X | Xs], Ys, [X | Zs]) :- append(Xs, Ys, Zs).

reverse([],[]).
reverse([H|T],Res):- reverse(T,Temp),append(Temp,[H],Res).
```

/* BRFRAMES.ARI CURRENT DATABASE 210196 */

```
f(rB1,[tx .. [v(means_of_escape_fire)],ss .. [v(fire_precautions)],rd .. [v(rd(rB1))]]).
f(means_of_escape_fire,[references .. [v(bRegs85_mandatory_rules)],concerns ..
[v(death_or_injury_from_fire)]]).
f(bRegs85_mandatory_rules,[generalisation .. [v(mandatory_rules)], entrenchment ..
[v(fire_escape_regulations)],inclusiveness .. [v(under)] ]).
f(death_or_injury_from_fire,[generalisation .. [v([suffocation,burning,collapse])]]).
f(fire_precautions,[domain .. [v(buildings)],subdomain .. [v(restricted_by_clause)],topic ..
[v(in_case_of_fire)]]).
f(buildings,[generalisation .. [v([permanent,temporary,part])],entrenchment ..
[v(with_roof_and_walls)],inclusiveness .. [v(under)],qual .. [v(is_erected)]]).
f(restricted_by_clause,[generalisation .. [v(none)]]).
f(in_case_of_fire,[generalisation .. [v(combustion)],entrenchment .. [v(permanent_fire_risk)] ]).
f(rd(rB1),[purpose .. [v(safe_escape)],entity .. [v(means_of_escape)],crt ..
[v(shall_have_bounded_feature(capable_of_being_used,bnds(at_all_material_times,no_max)))
]]).
f(safe_escape,[generalisation .. [v(rescueable)],entrenchment ..
[v(within_30_mins)],inclusiveness .. [v(under)]]).
```

```
f(means_of_escape,[generalisation ..
[v([safe_route,structural,from_any_point_in_building])],entrenchment ..
[v(protected)],inclusiveness .. [v(over)],qual .. [v(to_place_of_safety_outside)]]).
f(capable_of_being_used,[generalisation .. [v(without_assistance)],entrenchment ..
[v(by_ambulant_persons)],qual .. [v(safely_and_effectively)]]).
f(at_all_material_times,[generalisation .. [v(none)],entrenchment ..
[v(continuously)],inclusiveness .. [v(over)]]).
f(no_max,[generalisation .. [v(no_upper_limit)]]).
f(rB1_1ai,[ tx .. [v(means_of_escape_fire_dh)], ss .. [v(fire_precautions_dh)],ako..[v(rB1)] ]).
f(means_of_escape_fire_dh,[ako .. [v(means_of_escape_fire)], references ..
[v([bRegs85_mandatory_rules ,bS5588_s1])] ] ).
f([bRegs85_mandatory_rules, bS5588_s1], [generalisation ..
[v([mandatory_rules,cp_single_family_dwellings])], entrenchment ..
[v(fire_escape_regulations)], inclusiveness .. [v(under)] ]).
f(fire_precautions_dh,[ako .. [v(fire_precautions)],subdomain .. [v(dwellinghouse)]]).
f(dwellinghouse,[generalisation .. [v(over_two_storeys)],entrenchment ..
[v(has_floor_over_4500_above_gl)],inclusiveness .. [v(under)],qual ..
[v(does_not_contain_flat)]]).
f(rd(rB1_1ai),[ako .. [v(rd(rB1))]]).
f(rB1_1aii,[tx .. [v(means_of_escape_fire_flats)],ss .. [v(fire_precautions_flats)],rd ..
[v(rd(rB1_1aii))]]).
f(means_of_escape_fire_flats,[ako .. [v(means_of_escape_fire)],references ..
[v([bRegs85_mandatory_rules, bsCP3_ch4_pt1])] ]).
f([bRegs85_mandatory_rules, bsCP3_ch4_pt1],[generalisation ..
[v([mandatory_rules,flats_and_maisonettes])], entrenchment .. [v(fire_escape_regulations)],
inclusiveness .. [v(under)] ]).
f(fire_precautions_flats,[ako .. [v(fire_precautions)],subdomain .. [v(contains_flat)]]).
f(contains_flat,[generalisation ..
[v([separate_self_contained_dwelling,part_of_building,horizontally_separated])],entrenchment
.. [v(has_floor_over_4500_above_gl)],inclusiveness .. [v(under)],use .. [v(residentail)]]).
f(rd(rB1_1aii),[ako .. [v(rd(rB1))]]).
f(rB1_1aiii,[tx .. [v(means_of_escape_fire_offices)],ss .. [v(fire_precautions_offices)],rd ..
[v(rd(rB1_1aiii))]]).
f(means_of_escape_fire_offices,[ako .. [v(means_of_escape_fire)],references ..
[v([bRegs85_mandatory_rules, bS5588_p1])] ]).
f([bRegs85_mandatory_rules, bS5588_p1],[generalisation .. [v([mandatory_rules,cp_offices])],
entrenchment .. [v(fire_escape_regulations)],inclusiveness .. [v(under)]]).
f(fire_precautions_offices,[ako .. [v(fire_precautions)],subdomain .. [v(contains_offices)]]).
f(contains_offices,[generalisation .. [v(clerical_workplace)],entrenchment ..
[v(not_retail)],inclusiveness .. [v(under)]]).
f(rd(rB1_1aiii),[ako .. [v(rd(rB1))]]).
f([bRegs85_mandatory_rules, bsCP3_ch4_pt2],[generalisation ..
[v([mandatory_rules,cp_shops])], entrenchment .. [v(fire_escape_regulations)],inclusiveness ..
[v(under)]]).
f(means_of_escape_fire_shops,[ako .. [v(means_of_escape_fire)],references ..
[v([bRegs85_mandatory_rules, bsCP3_ch4_pt2])] ]).
f(contains_shop,[generalisation .. [v(retail_premises)],inclusiveness .. [v(under)]]).
f(fire_precautions_shops,[ako .. [v(fire_precautions)],subdomain .. [v(contains_shop)]]).
f(rB1_1aiv,[tx .. [v(means_of_escape_fire_shops)],ss .. [v(fire_precautions_shops)],rd ..
[v(rd(rB1))]]).
f(rd(rB1_1b),[ako .. [v(rd(rB1))]]).
f(rB1_1b,[ako .. [v(rB1)],ss .. [v(fire_precautions_dh_alt)] ]).
f(fire_precautions_dh_alt,[ako .. [v(fire_precautions)],subdomain .. [v(altered_dwelling_house)]
]).
f(altered_dwelling_house,[generalisation .. [v(permanent_or_temporary_or_part)],entrenchment
.. [v(with_roof_and_walls)],inclusiveness .. [v(under)],qual ..
[v(extended_or_materially_altered)]]).
```

```
f(fire_precautions_dh_alt,[ako .. [v(fire_precautions)],subdomain ..
[v(altered_dwelling_house)]]).
f(rB1_1b,[tx .. [v(means_of_escape_fire_altered_dh)],ss .. [v(fire_precautions_dh_alt)],rd ..
[v(rd(rB1_1b))]]).
f(altered_to_dwellinghouse,[generalisation .. [v([permanent,temporary,part])],entrenchment ..
[v(with_roof_and_walls)],inclusiveness .. [v(under)],qual ..
[v(use_to_be_materially_changed)]]).
f(fire_precautions_use_change_to_dh,[ako .. [v(fire_precautions)],subdomain ..
[v(altered_to_dwellinghouse)]]).
f(rB1_1c,[ako .. [v(rB1_1ai)],ss .. [v(fire_precautions_use_change_to_dh)] ]).
f(rB1_1bBb,[tx .. [v(means_of_escape_fire_dh)],ss .. [v(fire_precautions_dh_loft_conv)],rd ..
[v(rd(rB1_1bBb))]]).
f(fire_precautions_dh_loft_conv,[ako .. [v(fire_precautions)], subdomain .. [v(loft_conversions)]
]).
f(loft_conversions, [generalisation .. [v([one_or_two_habitable_rooms])], entrenchment ..
[v(in_roof_space)],inclusiveness .. [v(under)],qual .. [v(new_storey)]]).
f(rd(rB1_1bBb),[ako .. [v(rd(rB1))], crt .. [v(shall_have_bounded_feature(fire_door_protection,
bnds(all_doors_to_enclosure,no_max)))]]).
f(fire_door_protection,[generalisation .. [v([fire_resistlng_enclosure,self_closlng])],entrenchment
.. [v(half_hour)], inclusiveness .. [v(over)],qual .. [v(to_BS476_part8)] ]).
f(all_doors_to_enclosure,[generalisation .. [v(none)], inclusiveness .. [v(over)]]).
f(rB1_1bBc,[ako.. [v(rB1_1bBb)], rd .. [v(rd(rB1_1bBc))]]).
f(rd(rB1_1bBc),[ako .. [v(rd(rB1))], crt .. [v(shall_have_bounded_feature(escape_windows,
bnds(no_min, cill_max_1100)))]]).
f(escape_windows,[generalisation .. [v([window,rooflight])], entrenchment .. [v(openable)],
inclusiveness .. [v(over)]]).
f(cill_max_1100,[generalisation .. [v(to_bottom_of_opening)], entrenchment ..
[v(from_floor_level)], inclusiveness .. [v(over)] ]).
f(no_other_regs_implied,[generalisation .. [v(none)]]).
f(food_poisoning,[generalisation .. [v(risks_to_health_of_persons_in_buildings)]]).
f(g1_food_storage,[references .. [v(no_other_regs_implied)],concerns .. [v(food_poisoning)]]).
f(dwellings,[generalisation .. [v(more_than_one_bed)]]).
f(food_storage,[generalisation .. [v(none)]]).
f(new_dwelling_food,[domain .. [v(buildings)],subdomain .. [v(dwellings)],topic ..
[v(food_storage)]]).
f(ensure_food_storage_provision,[generalisation ..
[v(reduce_risks_to_health_of_persons_in_buildings)]]).
f(accommodation,[generalisation .. [v(separate_room)],entrenchment .. [v(larder)]]).
f(capacity,[generalisation .. [v(volume)],inclusiveness .. [v(under)]]).
f(rd(rG1_1a),[purpose .. [v(ensure_food_storage_provision)],entity .. [v(accommodation)],crt ..
[v(shall_have_bounded_feature(capacity,bnds(sufficient,no_max)))]]).
f(sufficient,[generalisation .. [v(m3_1point75)]]).
f(rG1_1a,[tx .. [v(g1_food_storage)],ss .. [v(new_dwelling_food)],rd .. [v(rd(rG1_1a))]]).
f(bs6465_pt1,[generalisation .. [v(sanitary_appliances)],extra_refs ..
[v([bAct84_s65,ph_Act36_s51,o_s_rway_prems_Act,food_hygiene_70_Regs])]]).
f([personal_cleanliness,bacterial_spread],[generalisation ..
[v([physical_contact,inadequate_provision])],entrenchment .. [v(airborne_germs)]]).
f(sanitary_facilities,[references .. [v(bs6465_pt1)],concerns ..
[v([personal_cleanliness,bacterial_spread])]]).
f(none,[generalisation .. [v(nil)]]).
f(sanitary_conveniences,[generalisation .. [v(toilets)]]).
f(b_wks_sanitation,[domain .. [v(buildings)],subdomain .. [v(varies)],topic ..
[v(sanitary_conveniences)],specifics ..
[v([workplaces,o_s_rway_prems_Act,food_businesses])]]).
f(hygiene,[generalisation .. [v(reduce_risks_to_health_of_persons_In_buildings)]]).
f(sanitary_conveniences,[generalisation .. [v(closets_urinals)]]).
f(sufficiency,[generalisation .. [v(defined_by_building_type)]]).
```

f(rd(rG_4a),[purpose .. [v(hygiene)],entity .. [v(sanitary_conveniences)],crt ..
[v(shall_have_bounded_feature(sufficiency,bnds(one_closet,no_max)))]]).
f(rG_4a,[tx .. [v(sanitary_facilities)],ss .. [v(b_wks_sanitation)],rd .. [v(rd(rG_4a))]]).
f(one_cioset,[generalisation .. [v(with_hand_basin)],entrenchment .. [v(ventilated)]]).
f(varies,[generalisation .. [v(defined_by_building_type)]]).
f([workplaces,o_s_rway_prems_Act,food_businesses],[generalisation ..
[v(set_by_relevant_regs)]]).
f(siting,[generalisation .. [v(position)]]).
f(separated_from_food_storage_or_preparation,[generalisation ..
[v(not_open_into_such_space)]]).
f(rd(rG_4b),[ako .. [v(rd(rG_4a))],crt ..
[v(shall_have_bounded_feature(siting,bnds(separated_from_food_storage_or_preparation,no_
max)))]]).
f(rG_4b,[tx .. [v(sanitary_facilities)],ss .. [v(b_wks_sanitation)],rd .. [v(rd(rG_4b))]]).
f(easily_cleaned,[generalisation .. [v(smooth_impervious)]]).
f(surface,[generalisation .. [v(none)]]).
f(rd(rG_4c),[ako .. [v(rd(rG_4a))],crt ..
[v(shall_have_bounded_feature(surface,bnds(easily_cleaned,no_max)))]]).
f(rG_4c,[tx .. [v(sanitary_facilities)],ss .. [v(b_wks_sanitation)],rd .. [v(rd(rG_4c))]]).
f(fire_resistance_of_structure,[references .. [v(bs476_Fire_Tests)],concerns ..
[v([risk_of_fire_spread,collapse])]]).
f([risk_of_fire_spread,collapse],[generalisation .. [v(entrapment)]]).
f(institutional,[generalisation .. [v(residential_for_disabled_or_aged_or_under_5)]]).
f(bs476_Fire_Tests,[generalisation .. [v(part8_fire_resistance_of_elements)]]).
f(structural_fire_resistance,[generalisation .. [v(period_to_retain_integrity)]]).
f(fire_protection_inst,[domain .. [v(buildings)],subdomain .. [v(institutional)],topic ..
[v(structural_fire_resistance)]]).
f(maintain_str_stability,[generalisation .. [v(avoid_premature_failure)],entrenchment ..
[v([retain_strength_to_allow_escape,prevent_fire_spread])]]).
f(compartmental_elements,[generalisation .. [v([frames,beams,columns,floors,galleries])]]).
f(fire_resistance_boundary_elements,[generalisation ..
[v(specified_min_period_of_fire_resistance)],entrenchment .. [v(table_A3_p42)]]).
f(hours_1,[generalisation .. [v(longest_period)]]).
f(rd(rB3_2inst),[purpose .. [v(maintain_str_stability)],entity .. [v(compartmental_elements)],crt ..
[v(shall_have_bounded_feature(fire_resistance_boundary_elements,bnds(hours_1,no_max)))]])
.
f(rB3_2inst,[tx .. [v(fire_resistance_of_structure)],ss .. [v(fire_protection_inst)],rd ..
[v(rd(rB3_2inst))]]).
f(bs5395,[generalisation .. [v([part1_cp_stairs,amd3355,amd4450])]]).
f(risk_of_falling,[generalisation .. [v(safety_in_buildings)]]).
f(stairways,[references .. [v(bs5395)],concerns .. [v(risk_of_falling)]]).
f(buildings,[generalisation .. [v(ab4)]]).
f(single_dwelling,[generalisation .. [v(inc_dwellinghouse_and_flats)],entrenchment ..
[v([house,access_stair])],inclusiveness .. [v(under)],qual .. [v(not_ladders)]]).
f(requirements_of_stairs,[generalisation .. [v(design_criteria)]]).
f(stairs,[domain .. [v(buildings)],subdomain .. [v(single_dwelling)],topic ..
[v(requirements_of_stairs)]]).
f(avoid_risk_of_falling,[generalisation .. [v(afford_safe_passage)],entrenchment ..
[v(safe_to_climb_or_descend)]]).
f(private_stairway,[generalisation .. [v(staircase)],check .. [v(means_of_escape)]]).
f(pitch,[generalisation .. [v(steepness_of_stairs)],entrenchment ..
[v(line_connecting_nosings)]]).
f(no_min,[generalisation .. [v(only_maximum)]]).
f(degrees42,[generalisation .. [v(steepest)],inclusiveness .. [v(under)]]).
f(rd(rK1_14),[purpose .. [v(avoid_risk_of_falling)],entity .. [v(private_stairway)],crt ..
[v(shall_have_bounded_feature(pitch,bnds(no_min,degrees42)))]]).
f(rK1_14,[tx .. [v(stairways)],ss .. [v(stairs)],rd .. [v(rd(rK1_14))]]).

APPENDIX E

Example of Pre-analysis Sheet

PRE-ANALYSIS SHEET — STAIRWAYS AND RAMPS

REGULATION K1 | ID k1.1 | DATE 30129S

TEXT

Stairways (and ramps) shall be such as to afford safe passage (for the users of the building)

			generalisation	entrenchment	over-/under-inclusiveness	other
CONTEXT						
	References	in AD's	BS 5395	—	—	—
	Concerns	implied/risk of falling	none	accidents	—	—
SITUATIONAL SPECIFICATION						
	Domain	buildings	permanent, temporary, part	roofed, enclosed	under	is erected
	Subdomain	varies according to building type — private stairway as example	see Table 1 (AD)	house, semi-bungalow maisonette	under	means of escape access for disabled
	Topic	Stairway design (implied)	in or used by one dwelling	construction	over.	
			none			
RESPONSE DEFINITION						
	Purpose	Safe passage (for the users of the building)				
	Entity	Stairways	not ladders or outside building	Stairs, Staircase	under	
	Feature (AD)	steepness	pitch/line connecting nosings	—	—	—
	Bounds (AD) upper	42 degrees	none	—	—	—
	lower	no minimum	none	Controlled by rise/going	over	—

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